

HOW TO MAKE **WINDOWS 10 & 11** SAFER FOR FREE

# PC PRO

## INTEL'S AI CHIPS



First test of revolutionary Intel Core Ultra

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# BEST TECH 2024

What's new, what's hot  
and what's coming next



ISSUE 354

BONUS SOFTWARE CODE JR9PH2FS



## Give old PCs new life with Linux

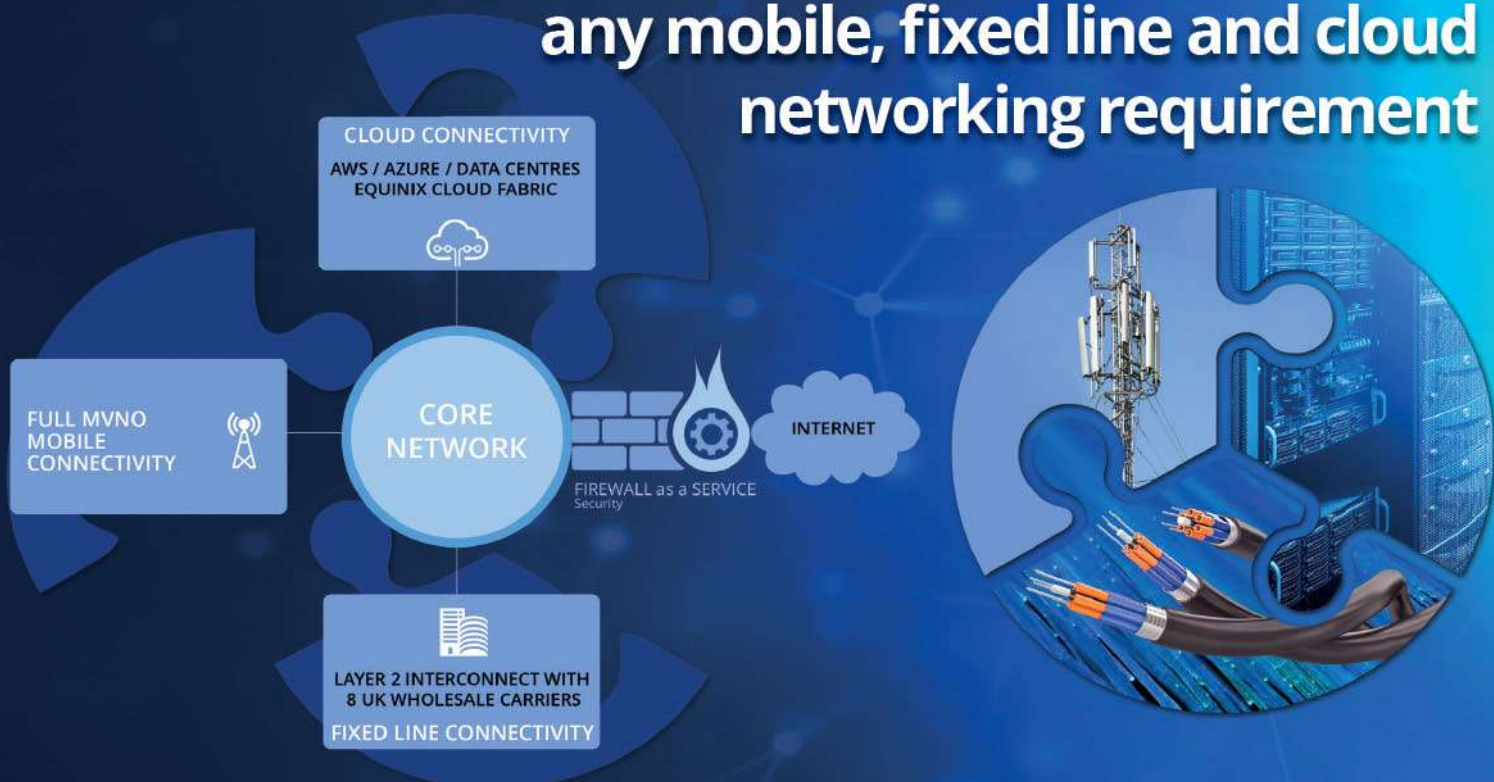
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## HIGHLIGHTS THIS MONTH

Full contents overleaf

### REVIEW OF THE MONTH

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#### Intel Core Ultra

A new brand for a new era of computing. Or at least, that's what Intel would like you to think. Here, we dig deep into technology behind the rebrand so that you can decide for yourself whether the new NPU, updated Arc graphics and all the power-based enhancements are worth it. (For the record, Intel claims 70% better AI efficiency, twice the graphics performance and a 25% reduction in power consumption.) Plus, we test the first laptop featuring an Intel Core Ultra chip.



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### SHOW AND TELL OF THE MONTH

We trawled the CES halls to find the most exciting products – and the bizarrst ones. With 37 innovations, ranging from earbuds to magic mirrors, something is sure to pique your interest.

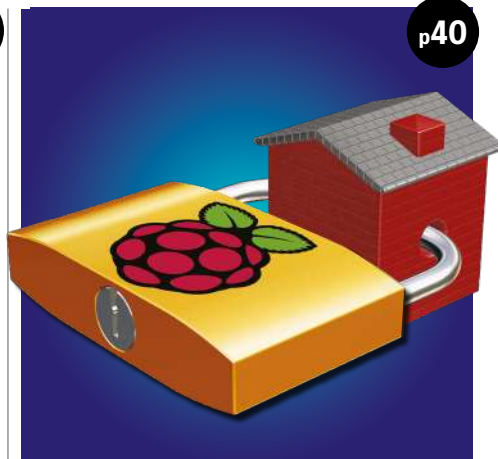
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### DEFENCE BOOSTER OF THE MONTH

Windows Defender is built into Windows 10 and 11, but are you taking full advantage of its power? Darien Graham-Smith explains the background and reveals how to get more from it.

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### PROJECT OF THE MONTH

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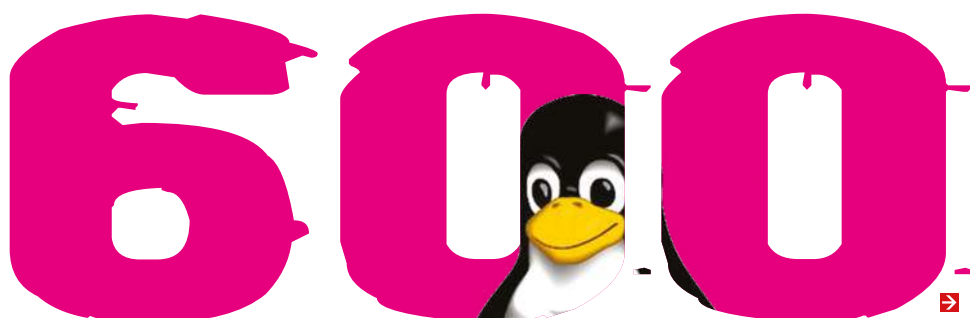


Some games deserve a place in computing history, and *Grand Theft Auto* is most definitely one of them. Here, we look at the story behind one of the biggest British hits ever.

### THE LABS IN ONE NUMBER

Would you believe that there are over 600 active Linux distributions to choose from? Fortunately, we've whittled the choice down to eight in our Linux Labs, so whether you're looking to switch from an old version of Windows or simply want to try something new, this test holds the answer.

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# PC PRO

## INTEL'S AI CHIPS

First test of revolutionary Intel Core Ultra



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# BEST TECH 2024

What's new, what's hot and what's coming next



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## Give old PCs new life with Linux

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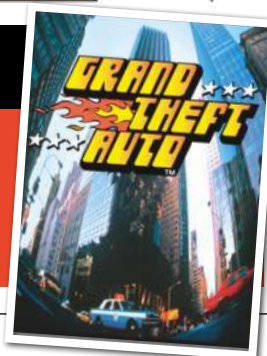
Brand new AI smarts, same old fantastic display and cameras: the Samsung Galaxy S24 Ultra is here



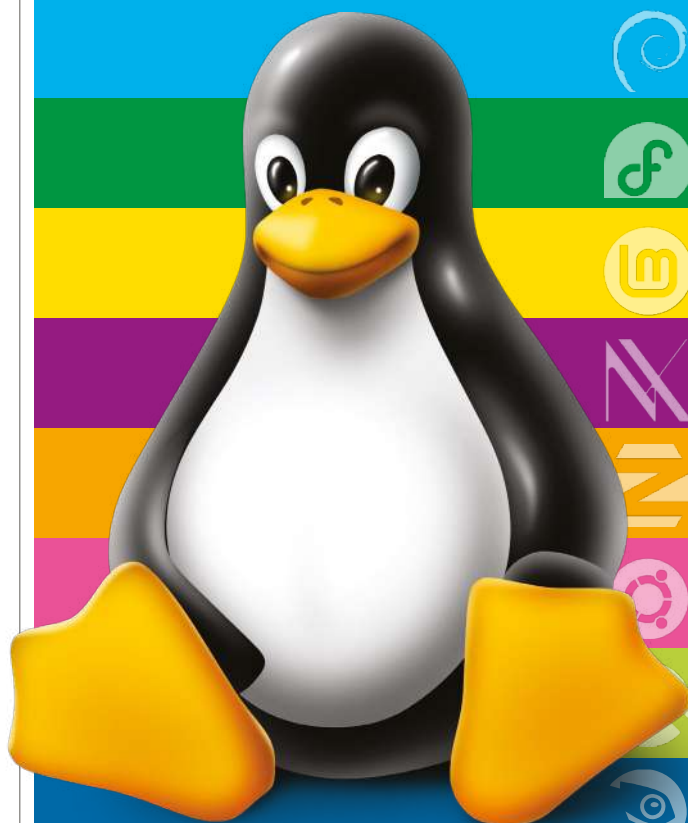
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# Don't read this column unless you're willing to shift a paradigm

**I** imagine for a moment that people spoke in real life as they do in the hyped-up tech-industry announcements we've grown used to. That the barista told you the latte you're about to drink is unique, transformative, revolutionary. We'd stare at them oddly, wish them a lovely day, and move slowly away. Yet in the bizarre world of tech marketing, that's exactly what we all put up with every day.

At the risk of triggering your flight-or-fight instincts, allow me to share some giveaway words. Top of my list: leverage, and, in particular, leveraging. I'm not a language snob, angry at the verbifying of a noun; heck, I just used the word verbifying, so I have no pride. I'm angry because it's so hackneyed, so over-used, that its sole remaining meaning is to act as a Danger Will Robinson red flag about the sentence that follows.

Similar emotions bubble within me whenever I see empower, immersive, revolutionary, innovative, seamless, next-level, disruptive and impactful, to the point where I should take the time to set up an Outlook rule that sends all emails containing these words to my spam folder. Sorry: I mean, create a unique, mind-blowing,

paradigm-shifting AI algorithm that will revolutionise my day.

Let me give two real-world examples from products we review in this month's magazine. One brand (and, in a cynical attempt to keep you reading, I won't tell you which until the end of the column) says that its new product will "supercharge your everyday with advanced AI". Another claims that its screen is "smooth beyond belief". Indeed, this product allegedly "redefines the meaning of smooth". I'll let the Oxford Dictionary know, if you don't mind informing Merriam-Webster?

By this point, I suspect you're thinking I'm a grumpy, cantankerous git who needs to get a life. And in this you are correct. But admit it: you feel the same, right? When you read those words, your subconscious agrees with me, silently marking each one down as meaningless waffle.

The sad thing is, those words used to have meaning. We know something that's truly "revolutionary" when we see it, because it comes along so rarely. In my experience, something is revolutionary not when a press release says so but when non-techie people talk to me about it. And that list of breakthrough products is tiny:

ChatGPT alone in the past five years, I would suggest.

But my real message to the marketers is that it need not be this way. Here, for example, is how Intel describes the Core Ultra family on its product page: "New AI experiences, performance, and battery that lasts." No hyperbole, no exaggeration, and straight to the point.

Not that Intel is immune to the lure of marketing-speak; on the same page, it claims its Arc GPU provides "immersive, high-realism gaming", which doesn't match my early experiences (see p46). Then again, the line "a bit better than it was previously" doesn't have quite the same punch.

But now for the moment you've been waiting for. The first product, ready to "supercharge your everyday"? Samsung's Galaxy S24 Ultra, reviewed on p58. And that smooth-tongued nonsense describes the otherwise fine phone known as the OnePlus 12 (see p60). Now, if you'll excuse me, I need to transform myself in a radical, axis-bending transition. By which I mean, go and have a nice lie-down.

**Tim Danton**  
Editor-in-chief

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**Jon Honeyball**  
When your dishwasher stops working, you probably call a plumber. For Jon, it prompted a deep dive into VLANs and the perils of dual-band SSIDs. See p110.



**Nik Rawlinson**  
This month, Nik not only explains how to build a security system using a Raspberry Pi (see p40) but also reveals which Linux distro is best for which purpose from p78.



**Davey Winder**  
If you're concerned that password managers are no longer safe havens after a bunch of security scares, Davey has some reassuring words (and suggestions) from p118.



**Rois Ni Thuama**  
Rois is driven round the bend, and nearly off the mountain, using an app that prioritises expense management over her safety. Find out what happened next on p116.

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To tie in with our Labs on Linux distros on p78, we asked our contributors: when did you last fire up a Linux distro and what for? And if you haven't, what's stopping you?

"It must have been four years ago in my final, ill-fated attempt to interest my children in the Raspberry Pi. My only consolation is that one of them did go on to study Computer Science at A-level!"

"Last week on my Chromebook. I fire up the built-in Linux console whenever I need to do structural management of my Android storage, like deleting folders."

"I used the Debian-based Raspberry Pi OS just a few weeks ago – I was toying with setting up the Pi 5 as a desktop computer for Scarlett, but she decided she's happy with her Chromebook."

"A month or so ago when I fired up my ten-year-old iMac, which runs on Linux Mint. It makes the system usable, unlike the last supported version of macOS."

"This morning. To write (Ubuntu 23.10 on a Ryzen 5 machine) and to make art (Raspberry Pi OS on Raspberry Pi 5 driving an AxiDraw plotter)."

"CloneZilla comes out several times a week for data recovery and disk imaging jobs. I also use a bootable Mint to grab files when Windows keels over."

"This morning, when I used Linux Mint to check something in LibreOffice as it looked odd in Excel on my Mac."

"Never did I ever fire up Linux distro. Do I drink or you drink? I forget how this game works. Anyway I'm about to address my tech deficit. Watch this space over the next few weeks!"

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# Briefing

Background and analysis on all the important

## Chatbots that sound just like us

Voice cloning breakthrough will make AI assistants sound less synthetic

**W**hen you're talking to Siri, Alexa or the Google Assistant, you could be forgiven for thinking that they sound a bit flat. Whether it's sharing the excitement that your dinner delivery is nearby, or breaking the bad news that thunderous showers are expected, voice assistants all sound like emotionless robots. But all that could be about to change.

OpenVoice is a new proof-of-concept AI tool that, its creators claim, can clone any voice with only a few seconds of reference audio.

What really sets it apart from previous attempts at voice cloning is that it's significantly more flexible, as different speech characteristics can be easily tweaked. For example, you can instruct the AI to make the voice sound happy, sad or even terrified. Or if you want to go for a different regional appeal, you can even switch the voice's accent – perhaps making a previously American voice sound more British, Australian or South African.

The hope is the technology will improve how we interact with AI tools like chatbots, such as those made by parent company MyShell, to make them appear more lifelike. “The voice-cloning model enables very flexible content creation and the design of human-computer interfaces,” said Zengyi Qin, an MIT researcher who led the project. “So, this could be a very important part in the future of artificial general intelligence.

“Language, vision and voice are [the] three most important modalities in artificial intelligence in the future,” added Qin. “There are some pretty good open-source projects in the language models and vision models [categories], but nobody could do the voice models as good as the previous two.”

### ■ Voice breaking

So how is it done? The trick is to break the “reference” clip into its different components.

“Flexibility here means after you control the voice, you have flexible control of styles like the accent, like

**ABOVE OpenVoice claims it can clone any voice – and say it with emotion**

the emotion and the intonation,” said Qin. “To enable such level of detail control is very difficult, because that will require a huge dataset to train it and a very large model to learn it.”

Luckily, then, Qin and his colleagues were able to use around 100,000 clips of audio training data – and that appears to have been enough to figure it out.

What makes OpenVoice so powerful is that the AI breaks a voice clip into these different characteristics, and applies AI to each element independently – similar to how AI art tools can apply the overall artistic style of Van Gogh to any picture, not merely paintings of sunflowers.

However, Qin says that achieving this with voice data is much trickier. “When the computer analyses the voice or the audio, it actually needs

to convert the audio into a spectrogram, and that spectrogram is too hard for humans to understand. So

**“You can instruct the AI to make the voice sound happy, sad or even terrified”**



that makes the manipulation of voice much, much more difficult than the manipulation of images.”

The researchers have also discovered that treating these different characteristics separately can deliver clever results. For example, using OpenVoice it's possible for a synthetic voice to retain the tone with which a text is being read, while making it possible to swap out the text being spoken entirely. In fact, using this technique, it's even possible to change the language being spoken, while having the voice still sound as though it's being read by the same person.

The results, which can be heard at [openvoice.uk.com](https://openvoice.uk.com), literally speak for themselves. While the generated voices aren't perfect, they're almost perfect – and certainly a step change in capability from what was previously possible.

Under the hood, the underlying code is potentially exciting, too. The system doesn't require a server farm – all it needs is a standard desktop PC, with the developers saying that it's notably less resource-heavy than prior voice cloning software.

There is one obvious question, though. Despite the many potential useful applications for the technology, surely it could be abused to make telemarketer scams even more realistic or for creating deep-fakes of politicians?

On this, Qin is almost breezily optimistic. “We internally have a very powerful fake voice detection system to classify whether [a] voice is generated or human spoken,” he said, adding the company plans to make it available to the public.

In any case, OpenVoice is now a proven technology that exists in the world. And the code has been released entirely as open source and posted on GitHub, for other developers to build upon. And it's here where Qin sees the most potential. “The most exciting part is that OpenVoice can serve as a general-purpose voice component for [a] future artificial intelligence system,” he said.

“I believe by enabling the customisation of voices, the voice interface will gradually become a fundamental infrastructure that [will be] the building blocks of entire AI applications.”

If OpenVoice does become the next big thing, remember that you heard it here first – in whatever accent or language you choose.

“The OpenVoice system doesn't require a server farm – all it needs is a standard desktop PC”

## One small text for man...

Starlink delivers SMS messaging to ordinary phones

Since 2021 it has been possible to get high-speed broadband almost anywhere on Earth, thanks to SpaceX's Starlink constellation. With upwards of 5,300 satellites currently in low-Earth orbit, the network has already accrued more than 2.3 million customers in rural and far-flung locations around the world, where terrestrial broadband doesn't reach at speed.

However, to make use of Starlink's capabilities you need a bulky satellite receiver, making it impractical for mobile use – at least, until now.

In January, the company launched the first six of a new iteration of its satellites with “Direct to Cell” capabilities, which it's hoped will enable an ordinary mobile phone to connect directly to the space-based network using 4G. A few days later, the company proved it possible by exchanging its first SMS text messages sent via satellite.

Given the words might go down in history like Alexander Graham-Bell's “Mr Watson come here”, and the “Merry Christmas” sent by two Vodafone engineers in 1992 as the first SMS, you'd think the SpaceX engineers would have chosen the wording of their first space-based text message carefully. What did they go for? “Such Signal”, with the reply “Much wow”, and three cry-laugh emojis. No need to rewrite the history books there, then...

What makes the service unique is that it really is using the standard 4G

spectrum, so that the phone in your pocket right now could conceivably connect to Starlink, without the user realising that the mast it is connected to is not on the ground, but floating above it in space.

However, we should perhaps temper our expectations as to what the service might eventually look like. “If the base station is now about 600 kilometres above you, there is no way it's going to give you exactly the same service, because it's unmodified – the handsets are the [same] one you have,” said Peter Kibutu, advanced technology lead at satellite consultancy TTP. “They can compensate for that by having very large satellites, for example, to improve the link... but you wouldn't expect it to be effectively the same as a [terrestrial] cellular base station.”

That's why SpaceX has been managing expectations. The company says that it expects to begin offering space-based SMS services later this year, with voice and data to follow in 2025, though there are no indications yet on expected speeds.

SpaceX has already signed up a number of network partners, including T-Mobile in the US. Though no UK partners have yet been announced, BT/EE is reportedly working with SpaceX on using Starlink for its own backhaul capabilities – so the beginnings of a relationship between the companies appears to be there.



Your phone could soon be sending messages via satellite thanks to SpaceX's Starlink constellation

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## Open book: the British Library hack

How did a great British institution get taken down?

James O'Malley investigates

Since the 17th century, the British Library and its predecessor institutions have been home to one of the most important collections of documents, books and periodicals in the world. Today, it's our national deposit library, and publishers have a legal obligation to file a copy of every new book published with the library. As such, it's a hugely important research institution, and the corridors and research rooms on any given day are usually packed with academics and scholars.

At least, that's what should be happening.

On the last weekend of October last year, disaster struck the library as a ransomware attack quietly spread across its systems, locking out researchers, staff and management alike. The hackers demanded payment to unlock the system, simultaneously threatening to release the personal data of many of the library's users if the institution didn't pay up.

"The people responsible for this cyberattack stand against everything that libraries represent: openness, empowerment, and access to knowledge," wrote British Library chief executive Sir Roly Keating in a blog post following the attack. (The British Library declined to speak to us directly.)

According to Keating, when the attack was spotted, action was quickly taken to lock down and isolate the library's network, but "significant damage was already done". He also notes that a staggering 600GB cache of data stolen from the library had already made its way onto the dark web, where the attackers were auctioning off the data to the highest bidder.

The damage to operations has also been severe. The Reading Rooms where researchers go to view documents have been unable to retrieve items from the library's vast collection, and digital services including a database of 600,000 doctoral theses have been rendered unavailable.

At the time of writing, almost four months after the attack, the recovery is still likely to take further "months", according to the Library. "The Library itself remains a crime scene," according to Keating.

All of which begs the question: how was a major British institution taken down so easily?

### ■ A basic attack

A hacking group called Rhysida, seemingly named after a species of centipede, claimed responsibility for the attack

## Ransomware-as-a-Service

Though Rhysida's means of attack may be unsophisticated, the business model behind the group is anything but. In recent years, the ransomware "industry" has evolved to a point where groups such as Rhysida now offer what has become known as "Ransomware-as-a-Service" – which to an extent apes the legitimate SaaS business model, as hackers sell their services to "customers" and offer extras such as technical and marketing support on top.

"They maintain the tools, they pick the targets, they deal with the victim of the attack, but then they work side by side with a hacker who they'll pay to actually carry out the hack and be able to make live decisions while they're inside the environment," said Daniel Clayton.

As a result of RaaS, the ransomware industry has specialised, with some hackers focused on phishing or stealing credentials, and others on deploying and developing the software. "Gangs are really good at this," said Clayton. "They've kind of turned ransomware into a business."

According to Clayton, this new form of attack is called a "triple extortion".

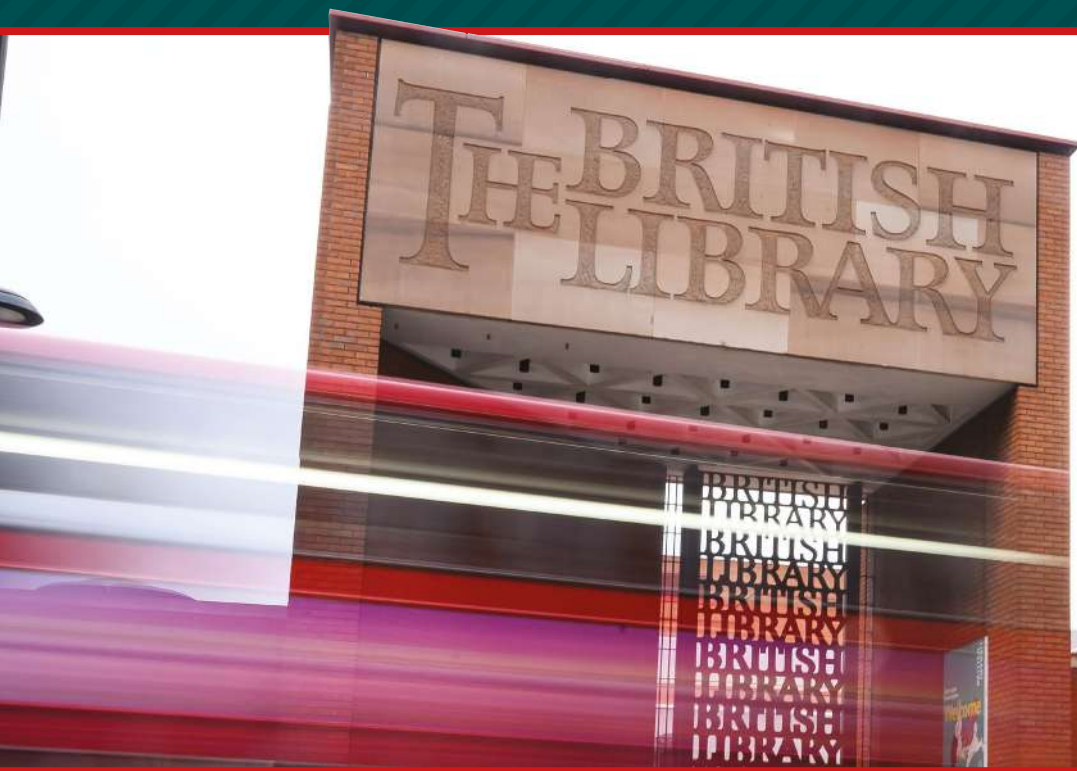
"We started off with ransomware as this technology-driven thing that was really about deploying a malware kit that would go and encrypt certain files in the environment," he said.

"Then they added an extortion element to it, which required them to exfiltrate data. And now what we're seeing is... the possibility of asking for additional money on top of that."

The additional income will arrive from the exfiltrated data being used to extort customers of the hacked service. So, for example, you could imagine a criminal gang acquiring the cache of British Library data that has leaked on to the dark web and using that to target library users to demand even more money.







### ■ Did the library pay?

Recovering from a ransomware attack is a very costly business. According to the *Financial Times*, the British Library is expecting to spend more than £6 million – almost 40% of its cash reserves – on simply getting back on its feet. That's approximately ten times the £600,000 that the Rhysida group demanded to unlock the British Library's systems, which the library refused to pay.

However, this cost disparity does raise a curious question for large organisations facing similar threats: is it better to quietly pay off the hackers and give in to their demands?

shortly after it occurred. The various security analysts we've spoken to weren't surprised that it happened. "There's been a steady warning of more and more of such attacks to be expected," said Deryck Mitchelson, CISO at security firm Check Point Software.

The nature of the target wasn't a surprise, either. "This ransomware crew specialises in not-for-profits," said Ian Thornton-Trump, CISO for security company Cyjax, who thinks the British Library was a particularly tasty target for the group, which is thought to have ties to Russia – a country that doesn't currently have the friendliest relationship with the west.

"If I was a ransomware operator, I would think of anything 'British' as being a very sexy target," said Thornton-Trump. "A library is even better because it's not like planes falling out of the sky. It's all tied to geopolitics in a lot of ways."

Yet despite the high-profile nature of the attack, and the potential political context, the truth is that the actual mechanics of the attack were probably not all that sophisticated. "[Hackers] love the kudos of doing something unusual that's brand new, a zero-day that only they've discovered," said Mitchelson. "But 99.9% of such attacks are not that good. They're standard phishing or remote access or a vulnerability, which is exactly what the British Library will be."

"Would I bet my house on it that it was either a remote access, a vulnerability or phishing? I would, absolutely."

Mitchelson added: "When you have a look at previous attacks they [Rhysida] have been involved in, they tend to not be too complex. They tend to use standard tools once they're into systems."

"If there's been a compromised account, they'll use XA processes, they'll use PowerShell in order to actually have a look around, they'll try and access credentials through PS exec type processes, they'll try to do lateral movement [across the network] using remote-desktop-type technologies."

Mitchelson said the group tend to "live off the land" and use tools that are natively part of the system they've broken into where possible, instead of deploying their own code. "[They] can be quite difficult to initially see because the administrator may well be using these processes as part of their system administration," he said.

**ABOVE** The British Library will take months to recover from the attack

That's a "complex business decision" for the victims of such attacks, said Daniel Clayton, vice-president of security operations at threat analysis firm Expel. "They have to weigh out the cost of the ransom with the cost of recovery."

Today, there's an entire cottage industry of security firms that will help organisations communicate and negotiate with hacking groups. "I don't tell them initially yes or no," said Mitchelson. "That conversation needs to be right for the organisation. You've just got to realise any time you pay a ransom, you're paying a criminal, and you're basically saying to the criminal you can get rewarded for doing something of criminality."

But this moral argument doesn't mean that it never happens. "It's wrong, everything about it is wrong, but in some organisations they may well be [saying] that's fine, it's criminality, but in fact what we're paying is going to be far less than it's going to cost us," said Mitchelson.

**“ What the British Library teaches us all is there are tough, hard decisions to make before the cyberattack happens ”**

He gives the example of the oil and gas industry, where paying off the criminals isn't unheard of, because even a single day of disrupted drilling could make a big impact on the bottom line. "The initial thing I would always say to an organisation is do you want to be engaging with these

[hackers]," said Mitchelson. "Not initially saying yes... but you want to be giving yourself some time to certainly have the dialogue to work out how you can mitigate or minimise that disruption."

In any case, it's probably a better idea not to get into this sort of mess to start with – and that means to avoid ransomware attacks, the only option the British Library and organisations like it have is to think ahead. "What the British Library teaches us all is there are tough, hard decisions to make before the cyberattack happens in terms of allocating money to cybersecurity and resilience," said Thornton-Trump. "And then there are hard choices to make afterwards."

"The poor IT guy is probably down in the basement going, man, it would be great if we could upgrade these Windows 7 boxes," he added.

# The A-List



The best products on the market, as picked by our editors

## PREMIUM LAPTOPS

### Apple MacBook Pro 16in (2023)

**M3 power from £1,699**  
from [apple.com/uk](https://apple.com/uk)

The M3 chips give the already brilliant MacBook Pro series a boost in games with no sacrifices elsewhere, so power users who are happy with Apple must grapple with the big decisions: which M3 chip, which size of screen, and how much RAM and storage?

**REVIEW** Issue 352, p46



## BUSINESS LAPTOPS

### Lenovo ThinkPad X1 Carbon Gen 11

**Business class from £1,583 exc VAT**  
from [lenovo.com](https://lenovo.com)

Fight past Lenovo's opaque pricing – another flash sale, really? – and you'll find a slim, powerful and long-lasting laptop for a competitive price. With a wide range of available configurations, all based on Intel's 13th generation Core chips, this is our top choice for all sizes of business.

**REVIEW** Issue 350, p85



## ALTERNATIVES

#### Asus Zenbook S 13 OLED (UX5304)

The perfect 13in laptop? At 1kg, it packs power along with 1TB of storage, a top-quality OLED panel and superb battery life. **£1,600 from** [uk.store.asus.com](https://uk.store.asus.com)

**REVIEW** Issue 348, p58

#### Samsung Galaxy Book3 Ultra

Samsung packs everything into this 16in laptop, from a superb AMOLED panel and a slim 1.8kg chassis to a Core i9 CPU and RTX 4070 graphics. Expensive but top quality. **From £2,449 from** [samsung.com/uk](https://samsung.com/uk)

**REVIEW** Issue 344, p46

#### Apple MacBook Air 15in

It's no MacBook Pro, but with an 8-core M2 chip the 15in MacBook Air offers solid performance and a spacious, good-looking display for a great price. **From £1,399 from** [apple.com/uk](https://apple.com/uk)

**REVIEW** Issue 347, p60

## GAMING LAPTOPS

### Asus ROG Zephyrus M16 (2023)

**Core i9/4090 for £4,100**  
from [rog.asus.com/uk](https://rog.asus.com/uk)

Asus includes everything in this gaming laptop, including a personalisable lid via a matrix of lights. And a 16in AMOLED screen, 2TB SSD and cutting-edge components. If the £4.1K price puts you off, Overclockers UK sells an RTX 4080 version with a plain lid for £3,300.

**REVIEW** Issue 343, p50



## ALTERNATIVES

#### Lenovo Legion 5i Pro (16in)

A great-value gaming laptop that's extracts the most from its powerful components. We love the keyboard, too. **Part code 82RF002LUK, £2,000 from** [lenovo.com/gb](https://lenovo.com/gb)

**REVIEW** Issue 337, p61

#### Lenovo Legion 9i Gen 8 (16in Intel)

The liquid-cooling system may be only for bragging rights, but this slim laptop delivers the goods with a superb 16in mini-LED screen. **RTX 4090, £4,180 inc VAT from** [lenovo.com](https://lenovo.com)

**REVIEW** Issue 353, p58

#### Razer Blade 18

A great advert for 18in gaming laptops, the Blade 18 partners a Core i9-13950HX with RTX 40-series graphics in a stunning, slim design. **From £2,900 from** [razer.com/gb-en](https://razer.com/gb-en)

**REVIEW** Issue 343, p52

## EVERYDAY LAPTOPS

### Honor MagicBook 16 X (2023)

**Full metal jacket for £700**  
from [hihonor.com](https://hihonor.com)

A high-quality all-metal chassis marks the MagicBook 16 X 2023 out from the budget laptop crowd, and it's packed with good-quality (albeit not top-quality) components, from a 12th gen Core i5 chip to a 1,920 x 1,200 16in IPS panel.

**REVIEW** Issue 348, p59



#### Asus Vivobook S 15 OLED

The Core i5 version of this 1.7kg laptop offers amazing quality for under a grand, including a high-quality 15.6in OLED display. **From £949 from** [pcpro.link/347asus2](https://pcpro.link/347asus2)

**REVIEW** Issue 347, p85

#### Microsoft Surface Laptop Go2

The Laptop Go 2 won our recent group test of affordable laptops thanks to its high-quality 12.5in screen, 1.1kg weight and sleek design. **£555 from** [microsoft.co.uk](https://microsoft.co.uk)

**REVIEW** Issue 347, p89

#### MSI Prestige 15

Not the most cultured laptop, but great value considering the connectivity, 15in screen, fast specs and a GeForce RTX 3050 GPU (part code A12UC-034UK). **£849 from** [laptopoutlet.co.uk](https://laptopoutlet.co.uk)

**REVIEW** Issue 347, p93

## CHROMEBOOKS

### Acer Chromebook Plus 515

Double power for £400

from currys.co.uk

An excellent debut for Google's Chromebook Plus initiative, with Intel's Core i3-1315U CPU providing the power, with 8GB of RAM and 256GB of storage for company. The chassis is well built, and the 15.6in screen is good for the price.

**REVIEW** Issue 351, p44



### Acer Chromebook Vero 514

Acer combines its eco-conscious Vero brand with Chrome OS to great effect in this surprisingly powerful 14in Chromebook. With a 12th generation Intel Core i5 processor, 8GB of RAM and a 256GB SSD, plus Chrome OS updates until 2030, it's a fine long-term investment that helps cut down on electronic waste.

**£599 from currys.co.uk**

**REVIEW** Issue 340, p54

### HP Elite Dragonfly Chromebook

This is quite simply the best business Chromebook around, although at the time of writing we're waiting for units to hit the market. Build quality is stunning, as is this 13.5in convertible's 1.3kg weight.

**From £1,000 from hp.co.uk.**

**REVIEW** Issue 337, p86

## EVERYDAY PCs

### Apple Mac mini (2023)

M2 masterpiece from £649

from apple.com/uk

The outside remains the same, but this simple yet effective update to the Mac mini introduces the M2 and M2 Pro processors with predictable effect. The entry-level price quickly rises once you start upgrading – moving from 8GB to 16GB costs £200, as does doubling the base storage from 256GB to 512GB – but there's enough power here to last you for years.

**REVIEW** Issue 343, p60



### Intel NUC Pro 13

If you don't need discrete graphics then Intel's mini PCs are a fantastic choice, being easy to upgrade, low on energy consumption and more than powerful enough to cope with Windows applications – despite being little larger than a coffee coaster.

**Barebones, from £350; full PCs,**

**from £600, from scan.co.uk**

**REVIEW** Issue 345, p48

### PCSpecialist Topaz Supreme

This is an all-AMD system, with a Ryzen 5 7600 partnered with Radeon RX 6600 graphics. That's enough for smooth 1080p gaming, and the Topaz also has 16GB of Corsair DDR5 RAM and a speedy 1TB SSD. At this price, it's simply fantastic value. **£899 from**

**pcspecialist.co.uk/reviews**

**REVIEW** Issue 347, p54

## ENTHUSIAST PCs

### Chillblast Apex Ryzen 9 RTX 4090 Gaming PC

7950X3D and RTX 4090 for £4,400

from chillblast.com

A brilliant choice if you're looking for easy expansion tomorrow coupled with cutting-edge gaming with high-quality components today.

**REVIEW** Issue 347, p52



### HP OMEN 45L (2023)

We tested the top-end 45L with a Core i9-13900K, GeForce RTX 4090 graphics and 64GB of RAM, and it doesn't come cheap. Switch to the Core i7/RTX 4070 Ti version, however, and the price almost halves without losing any of the superb design and build quality. **£4,800 from hp.co.uk**

**REVIEW** Issue 347, p50

### Alienware Aurora R16

An understated yet stylish gaming PC that runs quietly even when pushed. This rig has power where it counts, mixing Intel's latest CPUs with Nvidia's RTX GPUs. Choose an RTX 4070 or higher to benefit from the glass side and liquid cooling, which lifts it above rivals. **From £1,349 from dell.co.uk**

**REVIEW** Issue 349, p54

## ALL-IN-ONE PCs

### HP Envy 34 All-in-One

£2,099 widescreen wonder

from hp.com

Built around a high-quality 34in widescreen – which is perfect for viewing two windows side by side thanks to its 21:9 aspect ratio – this also comes with Nvidia RTX 3060 graphics. We're big fans of the magnetic 16-megapixel camera, too.

**REVIEW** Issue 335, p46



### Dell Inspiron 24 All-in-One

Despite being built to hit a price point, the Inspiron 24 All-in-One manages to look classy, include a good-quality, 1,920 x 1,080 24in panel and have enough power to breeze through a typical day's tasks. It even packs mod cons such as a 720p webcam. Superb value for money.

**From £599 from dell.co.uk**

**REVIEW** Issue 350, p47

### Apple iMac 24in (M3)

The iconic design remains the same, but the plain M3 chip inside the revamped iMac 24in is a revelation compared to the previous M1 version. The downside is that the base configuration includes a stingy 8GB of memory and a 256GB SSD.

**From £1,399 from apple.com/uk**

**REVIEW** Issue 352, p52

## CREATIVE WORKSTATIONS

### Scan 3XS GWP TR Ada

Record breaker for £14,167 exc VAT

from scan.co.uk

A 64-core Ryzen Threadripper 7980X blows everything that went before out of the water with multithreaded tasks, while Nvidia's RTX 6000 Ada graphics dominates for viewport acceleration and GPU rendering. Even storage throughput is unparalleled. With a striking chassis and brilliant build quality, you'll want for nothing.

**REVIEW** Issue 353, p52



### Armari Magnetar MC16R7

A strikingly fast workstation for the money, with Armari's customised liquid cooling extracting the most from an AMD Ryzen 9 7950X. With 64GB of DDR5 RAM and AMD's Radeon Pro W7800 in support, this is a fantastic value machine.

**£3,758 exc VAT from armari.com**

**REVIEW** Issue 348, p44

### PCSpecialist Onyx Pro

Even in a creative workstation, it makes a lot of sense to include Nvidia's consumer graphics due to its core-per-buck. Here, an Nvidia RTX 4090 partners with a Core i9-13900K and an incredible 192GB of RAM to tremendous effect. **£3,750 exc VAT from**

**pcspecialist.co.uk/reviews**

**REVIEW** Issue 348, p86





## TABLETS

### Apple iPad Pro 12.9in

**Simply the best, from £1,249**

from [apple.com/uk](https://apple.com/uk)

The best tablet out there thanks to Apple's powerful M2 chip, even if the upgrade prices sting in their usual fashion. In return you'll get a workhorse during the day (especially with the optional Magic Keyboard) and a brilliant entertainer at night.

**REVIEW** Issue 352, p84



### Samsung Galaxy Tab S9 Ultra

The best of the big-screen Android tablets, with the bonus of Samsung's DeX environment if you want to use it as a desktop replacement, while One UI lets you manage multiple windows and multitask between them. The 14.6in AMOLED screen is superb, too.

**From £1,199 from [samsung.com](https://samsung.com)**

**REVIEW** Issue 352, p87

### OnePlus Pad

The OnePlus fully justified its place in our luxury tablet Labs thanks to its outstanding build quality, slick performance and stunning 17-hour battery life. It's the best Android option outside of Samsung's Galaxy Tabs – and it won't do nearly so much damage to your wallet.

**£449 from [oneplus.com](https://oneplus.com)**

**REVIEW** Issue 352, p86

## EVERYDAY PHONES

### Motorola Moto G13

**Amazing quality for £150**

from [johnlewis.com](https://johnlewis.com)

If you only have £150 to spend on a phone then this is a simply brilliant choice. The camera produces superb results, the design is first class, and while it isn't the fastest performer it's fast enough – and the battery life is great.

**REVIEW** Issue 346, p73



### Google Pixel 7a

A phone that begs the question: why spend £150 more for the Pixel 7? With few compromises on the Pixel 7 – it uses the same processor and cameras and the only notable change is a smaller screen – this is the new mainstream pick for Google phone fans.

**128GB, £449 from [store.google.com](https://store.google.com)**

**REVIEW** Issue 346, p68

### Motorola Edge 30 Neo

This stylish and compact smartphone – reflected by a small-ish 4,200mAh battery – includes a gorgeous 6.3in OLED screen, nippy Snapdragon processor and a decent pair of cameras for a great price.

**£300 from [motorola.co.uk](https://motorola.co.uk)**

**REVIEW** Issue 348, p73

## PREMIUM PHONES

### NEW ENTRY

### Samsung Galaxy S24 Ultra

**AI cleverness from £1,249**

from [samsung.com/uk](https://samsung.com/uk)

The price is undeniably high but in return you get a bunch of AI tools that will genuinely save you time (and could also save you money in the long-term). While we miss the 10x optical zoom of the S23 Ultra, the 5x zoom camera and supporting cast capture brilliant images, while the S Pen is always on hand to



### Google Pixel 8

It's not a huge step up from the Pixel 7, but the added AI features are genuinely useful and it benefits from a handful of upgrades, too – including a 120Hz screen and the new Tensor G3 processor. If you don't mind the lack of optical zoom, it's a great buy for the price.

**128GB, £699 from [store.google.com](https://store.google.com)**

**REVIEW** Issue 351, p72

### Samsung Galaxy Z Flip5

While the Galaxy Z Fold5 has its undoubted attractions, the Flip5 pips it onto this A List slot thanks to it being £700 cheaper and through the usefulness of the expanded front display. It's also IP68 rated and packs a stellar chip, beating rival flip phones.

**From £1,049 from [samsung.com/uk](https://samsung.com/uk)**

**REVIEW** Issue 349, p70

## EVERYDAY MONITORS

### Lenovo ThinkVision P27u-20

**4K Thunderbolt, £550**

from [lenovo.com](https://lenovo.com)

We reviewed this when it cost £470, but even at £550 it's a superb buy. It's a top-quality 27in panel with a 4K resolution, and it packs superb connectivity, including Thunderbolt 4.

**REVIEW** Issue 344, p89



### AOC Q27P3CW

If you can't afford the ThinkVision P27u-20 then this 27in USB-C docking monitor, complete with solid image quality and a 1440p resolution, offers unmatched value at a shade over £300. It even includes a webcam that supports Windows Hello.

**£310 from [box.co.uk](https://box.co.uk)**

**REVIEW** Issue 344, p83

### Iiyama ProLite XCB3494WQSN

Curved 34in monitors proved a popular choice in our Labs, and although it had tough competition from the HP E34m G4 this Iiyama steals a spot on our A List due to Iiyama's twin focus on value and quality panels. There's even gaming potential.

**£400 from [scan.co.uk](https://scan.co.uk)**

**REVIEW** Issue 344, p88

## PROFESSIONAL MONITORS

### Eizo ColorEdge CG319X

**Creative masterclass, £3,960**

from [wexphotovideo.com](https://wexphotovideo.com)

As the price indicates, this monitor is for heavyweight creatives who demand the best in every discipline: HDR video editing, print layouts, professional photography and more besides. With superb coverage and accuracy across all spaces, plus a built-in calibrator, it justifies the investment.

**REVIEW** Issue 327, p81



### BenQ PD2725U

By no means a cheap 4K 27in monitor – unless you compare it to the Eizos – but it marries all-round quality with ease of use thanks to a puck that allows you to quickly move between settings. You can even daisy chain a second Thunderbolt 3 monitor for a monster setup.

**£859 from [photospecialist.co.uk](https://photospecialist.co.uk)**

**REVIEW** Issue 327, p80

### Eizo ColorEdge CG279X

Designers who need to work across different disciplines will love how easy it is to switch between the Adobe RGB, DCI-P3 and sRGB colour spaces using the Eizo's fantastic OSD. It's certainly not cheap for a 27in 1440p monitor, but it's packed with quality.

**£1,726 from [wexphotovideo.com](https://wexphotovideo.com)**

**REVIEW** Issue 327, p84

## WEBCAMS

### Epos Expand Vision 1

**Top-quality 4K video from £142**  
from [uk.insight.com](http://uk.insight.com)

Videoconferencing expert Epos claims the top spot with its first personal webcam. It delivers on all fronts: audio quality, colour accuracy and low-light performance, and all while undercutting the 4K Logitech opposition by £100.

**REVIEW** Issue 340, p74



### Aukey PC-W3 1080p Webcam

If the thought of spending £142 on a webcam has you spluttering into your microphone then you should consider this far cheaper but high-quality alternative. Its colours are low-key in comparison to the best, but it still produces a sharp and detailed image. **£13 from [ebay.co.uk](http://ebay.co.uk)**

**REVIEW** Issue 321, p72

### Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.

**£329 from [amazon.co.uk](http://amazon.co.uk)**

**REVIEW** Issue 352, p75

## HOME OFFICE PRINTERS

### Epson EcoTank ET-2830

**Ink tank all-in-one for £250**  
from [epson.co.uk](http://epson.co.uk)

Don't expect flashy features, but do expect fast print speeds, high-quality prints, scans and copies, plus phenomenally low running costs – even after you've exhausted the 6,000 pages' worth of bottled ink that comes with it.

**REVIEW** Issue 353, p85



### Canon Pixma TS8750

A fantastic choice for creative users that's equally at home printing photos as it is scanning artwork. Despite its high running costs, due to its reliance on cartridges, this is a superb all-in-one. **£159 from [printerbase.co.uk](http://printerbase.co.uk)**

**REVIEW** Issue 353, p86

### HP OfficeJet Pro 9012e

So long as your print volumes aren't huge – the running costs mount up – this is a superb all-in-one for home office usage. It's fast, robust, prints double-sided and produces strong all-round results.

**£208 from [printerland.com](http://printerland.com)**

**REVIEW** Issue 353, p87

## WORKGROUP PRINTERS

### Canon Maxify GX6550

**Ink tank all-in-one for £392 exc VAT**  
from [canon.co.uk](http://canon.co.uk)

Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.

**REVIEW** Issue 350, p58



### Brother HL-L9430CDN

This laser printer (not an all-in-one, so there's no scanning or copying functionality) is a great choice for a busy office, producing sharp black text and making a good job of colour graphics as well. All while doing so quickly with a competitive price per page. **£415 exc VAT from [printerland.co.uk](http://printerland.co.uk)**

**REVIEW** Issue 353, p84

### Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies. **£238 exc VAT from [printerbase.co.uk](http://printerbase.co.uk)**

**REVIEW** Issue 341, p87

## WIRELESS ROUTERS

### Netgear Nighthawk RAXE300

**Fast Wi-Fi 6E router, £350**  
from [amazon.co.uk](http://amazon.co.uk)

The RAXE500 (see right) is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.

**REVIEW** Issue 341, p68



### Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.

**£800 from [netgear.com](http://netgear.com)**

**REVIEW** Issue 353, p76

### Asus RT-AX59U

You can buy cheaper Wi-Fi 6 routers – such as the D-Link Eagle Pro AI R15 for £55 – but Asus' well-priced offering delivers strong performance along with lots of control and exceptional VPN support. **£125 from [uk.store.asus.com](http://uk.store.asus.com)**

**REVIEW** Issue 350, p57

## MESH WI-FI

### TP-Link Deco XE200

**Clever Wi-Fi 6E for £600**  
from [amazon.co.uk](http://amazon.co.uk)

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code BOBKTDPCW8) should be enough for most premises.

**REVIEW** Issue 349, p65



### Mercusys Halo H80X

A new subsidiary of TP-Link, Mercusys offers its parent brand's XE75 router some excellent value-for-money competition. Not as fast due to Wi-Fi 6 rather than Wi-Fi 6E, but it has all the bandwidth you need for everyday use and should deliver it stably throughout your house. There are plenty of features too. **2-pack, £161 from [ebuyer.com](http://ebuyer.com)**

**REVIEW** Issue 341, p71

### Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house. **2-pack, £380 from [amazon.co.uk](http://amazon.co.uk)**

**REVIEW** Issue 350, p54





## BUSINESS WI-FI

### Zyxel WAX640S-6E

Tri-band Wi-Fi 6E AP, £369 exc VAT

from broadbandbuyer.com

A nicely priced tri-band wireless access point ideally suited to businesses that want to provide the full range of wireless services. It's easy to deploy, wireless performance is good and Zyxel provides top-quality cloud management services.

**REVIEW** Issue 353, p100



### Asus ExpertWiFi EBM68

Small businesses will find much to like with this simple-to-manage Wi-Fi 6 access point. AiMesh makes it incredibly easy to expand wireless coverage, performance is reasonable and it includes an impressive range of network security features. **2-pack, £540 exc VAT from amazon.co.uk**

**REVIEW** Issue 353, p98

### Netgear WAX625

A great choice for SMBs seeking an easy wireless performance boost with minimum investment. This is an affordable Wi-Fi 6 AP with good speeds while Netgear's Insight provides smart cloud management services. **£224 exc VAT from broadbandbuyer.com**

**REVIEW** Issue 353, p99

## NAS SERVERS

### Synology DiskStation DS1823xs+

10GbE NAS, £1,413 exc VAT

from broadbandbuyer.com

This powerful eight-bay NAS is a great choice for SMBs that want plenty of capacity, features and performance at a reasonable price. The new DSM 7.2 software has security high on its agenda, and the icing on the cake is Synology's generous five-year warranty.

**REVIEW** Issue 346, p101



### Qnap TS-h987XU-RP

The TS-h987XU-RP is a ready-made hybrid storage solution for SMBs. This rack-friendly package offers a great specification for the price, and Qnap's QuTS hero software scores highly for its wealth of data-protection features and business apps. **Diskless, £3,292 exc VAT from broadbandbuyer.com**

**REVIEW** Issue 344, p96

### Synology DiskStation DS1522+

Small businesses that want a high-capacity desktop NAS at a good price will find Synology's DS1522+ a great choice. Performance over 10GbE is impeccable and the DSM software offers a fantastic range of storage features. **5-bay NAS, diskless £586 exc VAT from broadbandbuyer.com**

**REVIEW** Issue 344, p98

## VIDEOCONFERENCING

### Poly Studio X52 with TC10

Perfect middle man, £3,161 exc VAT

from meetingstore.co.uk

Ideal for businesses that want a professional videoconferencing solution for medium-sized meeting rooms. Video quality is excellent, speaker tracking fast, and the big choice of built-in VC apps makes it incredibly versatile.

**REVIEW** Issue 353, p102



### Owl Labs Owl Bar

As a standalone videoconferencing room solution the Owl Bar has plenty to offer, with good video quality and super-smooth speaker tracking. It really comes into its own when paired with an Owl 3, though, as this unleashes a completely new dimension to your meetings. **£1,999 exc VAT from owllabs.co.uk**

**REVIEW** Issue 352, p99

### Jabra PanaCast 50

This sleek cylinder delivers great video and audio quality, fast speaker tracking and a wealth of advanced features. Jabra's Xpress web portal offers smart remote management services, and the super-wide view helps make the PanaCast 50 ideal for all-inclusive meetings. **£867 exc VAT from uk.insight.com**

**REVIEW** Issue 354, p100

## NEW ENTRY

## SCANNERS

### Xerox D70n Scanner

Fast and furious, £765 exc VAT

from ballicom.co.uk

The D70n delivers a mighty scan speed together with a wealth of scan management tools and apps. Businesses that want a high-volume networked desktop scanner at an affordable price should put the Xerox at the top of their list.

**REVIEW** Issue 346, p99



### Brother ADS-4700W

A fine choice for small businesses, with an impressive range of scanning features at a price that can't be faulted. Output quality is top notch and the versatile LCD touchscreen menus provide great walk-up scan services. **£355 exc VAT from printerbase.co.uk**

**REVIEW** Issue 346, p96

### Epson WorkForce ES-C380W

An affordable choice for offices short on space. It delivers on its 30ppm speed promises, Epson's ScanSmart software offers plenty of management features, and its standalone mode makes it very accommodating. **£280 exc VAT from ballicom.co.uk**

**REVIEW** Issue 351, p101

## SERVERS

### Dell EMC PowerEdge T350

Xeon E-2300 power, from £1,399 exc VAT

from dell.co.uk

Perfect for SMBs and branch offices looking for an affordable and powerful single-socket tower server. Along with support for Xeon E-2300 CPUs and lots of memory, it has a high storage capacity, plenty of expansion space and is sturdily built.

**REVIEW** Issue 335, p98



### Dell EMC PowerEdge R250

With prices starting at around £850 exc VAT for a Pentium Gold CPU, and the option of Xeon E-2300 series chips from £1,461 exc VAT, this is a slim, rack-mounted alternative to the more high-powered T350 that's ideal for SMBs. **From £845 exc VAT from dell.co.uk**

**REVIEW** Issue 332, p98

### Broadberry CyberServe Xeon E-RS100-E10

This represents a powerful hardware package at a price that will please small businesses. We love its low-profile chassis and the fine selection of remote-management tools. It's a great alternative to the Dell EMC servers also listed here. **£983 exc VAT from broadberry.co.uk**

**REVIEW** Issue 318, p96

## SECURITY SOFTWARE

### G Data Total Security

A suite for power users with a host of useful features that offers formidable protection against viruses. **5 devices, \$82 per year (first year and renewals) from gdatasoftware.co.uk**  
**REVIEW** Issue 343, p83



### Avast One Essential

The only product in our tests to score a 100% protection rating for blocking all malicious files, this reliable choice is our pick of the free AV tools available and includes a free if limited VPN service. **Free from avast.com**  
**REVIEW** Issue 343, p82

### McAfee+ Advanced

A high-end choice with high-end features and support for an unlimited number of devices. Good value for the first year, but watch out for renewals. **Unlimited devices, £75 first year, £150 renewals from mcafee.com/en-gb**  
**REVIEW** Issue 343, p84

## VPNs

### NordVPN

NordVPN won our VPN Labs for the second time running thanks to its consistent, fast speeds, great security features and excellent support for video streaming. **£80 for two years from nordvpn.com**  
**REVIEW** Issue 349, p86



### ProtonVPN

The best free VPN service available, with quick speeds and unlimited bandwidth. The paid-for service isn't cheap, but offers a bunch of useful extra features that might just tempt you into coughing up. **Free from protonvpn.com**  
**REVIEW** Issue 349, p88

### Surfshark

The fastest VPN we've tested, and it's generally a good performer in our region-shifted streaming tests, too. Cancellation is trickier than it should be, but it's a great-value choice for heavy VPN users. **£56 for two years from surfshark.com**  
**REVIEW** Issue 349, p89

## PASSWORD MANAGERS

### NordPass

This hassle-free option is a great choice for both personal and business use, with a competitive price matched with all the features most people need. **£1.89 per month from nordpass.com**  
**REVIEW** Issue 350, p70



### Bitwarden

Free for individual use and open source, the only important thing Bitwarden lacks is phone support: it works with virtually every device and browser, and the paid option is well worth £10 per year. **Free from bitwarden.com**  
**REVIEW** Issue 350, p71

### Keeper

A great choice for businesses thanks to its focus on security and a zero-knowledge policy, and if you need more options then Keeper has them. **Business edition, from £2 per user per month from keepersecurity.com**  
**REVIEW** Issue 350, p72

## ENDPOINT PROTECTION

### Sophos Intercept X Advanced

Delivers a huge range of endpoint protection measures for the price. It's simple to deploy, device and user policies add flexibility, and seamless integration with the Sophos Central cloud portal makes management simple. **500-999 users, 1 year, £36.50 each exc VAT from enterpriseav.co.uk**  
**REVIEW** Issue 351, p98



## BUSINESS BACKUP

### Veritas Backup Exec 22.2

Our top pick for on-premises data protection, Veritas Backup Exec 22.2 offers a superb range of features, great value and backs this all up with swift deployment and an easy-to-use interface. **Simple Core Pack, 5 instances, £389 per year exc VAT from uk.insight.com**  
**REVIEW** Issue 350, p97



## VOIP SERVICES

### 3CX

SMEs worried about the cost and complexity of hosting an IP PBX will love 3CX's free offering. It's easy to use and provides all the call-handling services you need. **Free for 1-10 users from 3cx.com**  
**REVIEW** Issue 345, p96



### WithSecure Elements EPP and EDR

High levels of automation make WithSecure a great choice for SMBs that want endpoint protection on a plate. It's simple to deploy, offers a wealth of security features and is easily managed from the cloud. **100-499 devices, £37 each per year exc VAT from withsecure.com**  
**REVIEW** Issue 351, p99

### IDrive Business

SMBs that want affordable cloud backup and data recovery features will appreciate IDrive Business, with its extensive app and platform support. **2.5TB, £479 exc VAT per year from idrive.com**  
**REVIEW** Issue 347, p99

### Gradwell Wave

Ideal for SMEs that want the smoothest possible path to VoIP, this cloud-hosted service is easy to manage and packed with features. **Wave 100, from £7.50 exc VAT per user per month from gradwell.com**  
**REVIEW** Issue 345, p98

## NETWORK MONITORING

NEW ENTRY

### Progress WhatsUp Gold 2023.1

Simple to deploy and offers an impressive range of network-monitoring tools. The choice of licensing plans makes it an affordable option for SMBs, and support teams will love its smart dashboard and NOC views. **Enterprise, 50 devices, £1,192 exc VAT per year from whatsupgold.com**  
**REVIEW** Issue 354, p99



## REMOTE SUPPORT

### IDrive RemotePC Team

IDrive's RemotePC Team will appeal to SMBs that want affordable cloud-hosted remote support for their offices and home workers. It's exceedingly simple to deploy, easy to manage and delivers tough access security measures. **First year, 50 computers, £172 exc VAT from remotepc.com**  
**REVIEW** Issue 349, p98



## UTM APPLIANCES

NEW ENTRY

### WatchGuard Firebox T45-CW

Businesses that hate internet downtime will love WatchGuard's Firebox T45-CW. It provides a wealth of top-class security services, can be easily cloud managed and delivers seamless 5G WAN failover. **Appliance with 3yr TSS, £4,015 exc VAT from broadbandbuyer.com**  
**REVIEW** Issue 354, p103



### Paessler PRTG Network Monitor 23.4

NEW ENTRY

A highly versatile network-monitoring package that delivers a wealth of information, and its all-inclusive price makes it a great choice for SMBs. **1,000 sensors, 1yr maintenance, €2,649 exc VAT from paessler.com**  
**REVIEW** Issue 354, p98

### NetSupport Manager 14

Delivers a wealth of support tools, including secure access to home workers, and licensing plans are good value. **1-500 systems, perpetual licence, £10 each exc VAT from netsupportmanager.com**  
**REVIEW** Issue 349, p100

### Zyxel ZyWALL ATP500

This desktop appliance gives sophisticated protection against zero-day threats, is easily managed and very good value. **Appliance with 1yr Gold Security licence, £1,191 exc VAT from broadbandbuyer.com**  
**REVIEW** Issue 348, p99





# Why vintage hardware trumps the virtual



Dick Pountain is editorial fellow of *PC Pro*. He fancies himself as a blacksmith as well as a luthier. Email [dick@dickpountain.co.uk](mailto:dick@dickpountain.co.uk)

How ironic that the service pulling me back into the physical world is that most quintessential of digital products: YouTube

**F**or the past 30 years I've been dabbling in the digital arts. In music, in graphics and indeed in programming itself. Digital offers huge advantages over the physical world, in speed of production, editability and economy of experiment. You don't waste paint and canvas when creating an image in Photoshop, and there's no twanging of strings or blowing on hard reeds in Ableton. But for a while I've felt an increasing pull back toward the physical, and to judge by the content on YouTube I'm not alone.

If forced to change professions I'd probably become a luthier, repairing and fettling fine guitars (I'm not good enough at woodwork to actually make them). My first job would be to reset the neck angle on my beautiful red 1963 Hofner Verithin, currently unplayable, which would make it worth around £1,000. Old cars, motorbikes, musical instruments, toys and more can become more valuable (sometimes staggeringly so) with age. Most computers, on the other hand, become fit only for the skip.

Okay, there's a small community who cleverly deploy the marvellous little Raspberry Pi board to emulate and resurrect a handful of desirable vintage computers such as the Sinclair Spectrum or the original Apple Mac, but these illustrate the problem. The speed of progress in the IT industry makes its past vanish. TTL chips that are no longer made, lost storage media (8in floppy, you'll be lucky), operating systems and apps – but most of all, vanished esoteric knowledge. People who restore old cars or bikes can club together to have spares made by small metalwork shops. People who restore

violins or guitars can do it themselves with planes and chisels. But fabricating lost chips or etching PCBs to restore an old computer isn't feasible, and is also pointless when you can emulate them so effectively in software.

**W**earing my other hat, this one labelled social science, I'm a fan of the French sociologist Luc Boltanski, who has studied the way objects acquire value. In a 2014 paper "The Economic Life of Things", he and Arnaud Esquerre outlined three stages in the ageing of manufactured goods, from milk bottles to motor scooters, using axes such as disposability, uniqueness and portability.

In the first stage, objects get used and their price is determined by the cost of materials, energy and labour needed to make them; in the second stage people start to collect certain used objects – beer mats, stamps, bayonets, whatever – and value them by rarity. The third stage, the asset, sees the most rare and sought-after objects become too valuable to use – think Swiss watches, old master paintings, Ferraris. They're purchased by the rich as stores of value, thought to be safer than money or shares.

Boltanski and Esquerre did include laptops and smartphones in their study, placing them in the first stage. However, 2014 is a decade ago, a long time in IT, and that decade has seen YouTube rise from distributing amateur videos to a source of income for lots of people, by making videos about what I'm talking about here. Videos about restoring everything from coffee grinders to aeroplanes, do-it-yourself videos from metalwork

and carpentry to dangerous chemistry, and reviews of all kinds of objects. Many of the objects involved belong in the collectable class, while some, such as Dave Gilmour's, Eric Clapton's or

**“My favourite videos include a man who obtains dangerous chemicals, mixes them and choreographs the resulting explosions”**

Kurt Cobain's guitars, are assets worth more than £1 million. Comparatively few videos involve restoring computers, maybe because soldering is far less photogenic than carving or sand-blasting or blowing things up.

**I**'ve spent a frightening amount of time watching YouTube videos in recent years. My favourites include ChemicalForce, a man with an almost comic Russian accent who obtains dangerous chemicals, mixes them and choreographs the resulting explosions in slow motion and gorgeous colour with balletic skill. Then there's Hand Tool Rescue (stop that sniggering), who discovers and restores marvellous 19th and early 20th-century engineering tools, while I've watched any number of blacksmiths bash wrought iron into beautiful utensils (my father worked in the Sheffield steel industry).

I also watch The Trogly's Guitar Show, a daily vlog-style channel by a nerdy Texan who makes big bucks dealing online in modern Gibson and Fender guitars, buys and sells from other online sites, and thinks nothing of splurging \$5,000 on a promising one.

My favourite of all, though, is a genial, bearded Canadian chap called Ted Woodford who maintains and restores vintage guitars. After watching him do several dozen neck resets I feel, or perhaps delude myself, that I could do one myself on my Hofner. Virtual worlds and exotic AI-generated scenes are beginning to feel thin compared to the real chisels, spanners and explosions on YouTube, even though both only happen on my screen.

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**“Most computers become fit only for the skip. The speed of progress in the IT industry makes its past vanish”**

# Generative AI can't have it all for free

Artificial intelligence firms shouldn't get content effortlessly when everyone else has to ask first



Nicole Kobie is PC Pro's futures editor. If OpenAI could automate rights permissions requests, she might be more sympathetic. X@njkobie

**S**am Altman wants to work less than I do. Look, I don't blame him – but I also don't think it should happen.

What am I on about? OpenAI and its generative AI rivals need to be fed data, in particular written words. Existing models have been trained on datasets hoovered up from the web, and some of those datasets contain material under copyright, sparking lawsuits ranging from authors to the *New York Times*. Other publishers have opted to cut a deal, presumably meaning they'll get paid and perhaps some help using AI in their newsrooms.

As a journalist, this is frustrating: any media company selling my words to AI isn't giving me a kickback on the deal. But as a writer it's the former situation that I find more frustrating.

This is stark in my mind as I've just finished a book. A book in which I quote other books, news stories, archive materials and oral histories. For every single instance where I quote directly, I've had to ask permission.

Permissions are currently the bane of my existence. I thought compiling the bibliography was hell,

**“Permissions are the bane of my existence. I thought the bibliography was hell, but no, that was just the first circle”**

but no, that was just the first circle. This is worse. For every small quote I want to use, I have to log a request.

In some cases, this is easy. Just ping an email to a museum or publisher, explain the project, and ask if it's okay to use the specific quote, perhaps including the wider context. In other cases, it's much more complex. For two books, from each of which I wanted to quote a single line, I needed to register for a rights management platform. Not merely enter my email

and create a password: I had to fill out several pages of a poorly designed form with everything from who I am (reasonable) to how many copies are being printed, how much they'll be sold for and what countries we'd like rights for. If a second run is required or rights are sold in other countries, I need to do all this again.

Other publishers manage their own forms, asking for dozens of pieces of information. Some engage rights managers, who have their own platforms requiring registration and data inputting, as well as heavy fees – to use one single quote from the *New York Times*, I would be billed \$400 plus a \$100 processing fee by the newspaper's third-party rights provider. (That quote will be coming out, sadly.)

This has taken me days of work, and the worst part of is I haven't even heard back from every rightsholder.

**A**I builders, meanwhile, want much more than a single quote from the *New York Times* and other media creators – they want it all, without asking, for free. The argument is that using data out there on the web for training constitutes “fair use”.

What is fair use? In the US, it refers to a provision in copyright law that allows the use of brief excerpts of material under copyright

without permission or payment in specific circumstances, which can include education, criticism, reporting and research. In the UK, the law differs slightly but also allows text to be used in such cases, and data mining if it's non-commercial research. In the US, there's another clause that could benefit OpenAI et al: if the use of the work is transformative – if it changes it and the two works don't compete in the same market – then fair use can be invoked.

It's no surprise, therefore, that this is going to the courts. But OpenAI could have avoided the battle by being more like me, as inconvenient as it is: ask first, rather than beg forgiveness later.

Some if not most of my permission requests likely fall under fair use, but we're filing requests anyway, as my editor says, to be polite. Politeness may not be valued by Silicon Valley

**“It's high time Silicon Valley learned that a slower pace could be beneficial. Trust is going to prove important with AI. Why risk losing it so early?”**

behemoths hell-bent on changing the world, but getting media companies on side first might have been a better, albeit more onerous, route.

**I**nstead of hoovering up the entire internet as though online content is fair game for copying, what if AI companies had worked with media firms from the beginning, asking permission to use their archives to teach their models? One of the failings of these early generative AI models is that the datasets are poor quality and biased; working with content owners early on could have mitigated this.

I get that technology development feels like a race and skipping such a step may enable a company to launch first, with all the headlines and funding that promises, but it's high time Silicon Valley learned that a slower pace could be beneficial, too. Trust is going to prove important with AI. Why risk losing it so early?

OpenAI says in a blog post that “legal right is less important to us than being good citizens”. I haven't asked permission to use that quote, under fair use clauses pertaining to reporting but in particular to criticism – because that's clearly nonsense.

 [work@nicolekobie.com](mailto:work@nicolekobie.com)





# The roaming data nightmare returns in Vegas



Barry Collins is a former editor of *PC Pro* and has just completed his 13th CES. You would think he'd have got the hang of roaming by now. [@bazzacollins](#)

When in Rome, I'm covered. But when roaming in the USA, things revert to the bad old days of crippling data costs – or going back to basics

**P**reparing for a trip to Las Vegas is always fraught with dilemmas. Do I need a raincoat, just in case? Which of my 18 international plug adapters should I pack? One feather boa or two? However, one problem I thought I'd managed to quash for this year's CES jaunt (see p26 for the tech highlights) was roaming data. "Thought" being the operative word.

I use the blisteringly cheap Lebara as my mobile network here in the UK: the 15GB of data I get for £6.95 per month is cracking value, not least because Lebara throws in free EU roaming. In the US, however, it's a different matter. Last year, Lebara didn't even offer roaming data bundles for the trip to Vegas, meaning any data I used over there would be charged at some ridiculous rate per MB, where downloading an email attachment would cost you more than a two-bed flat in Didcot.

I swerved this by ordering an international SIM from SimCorner. This gave me 6GB of data for £27.50, and turned up a few days before I departed, meaning I could pop the SIM in my phone's secondary SIM slot, activate it when I got to Vegas, and switch off roaming.

This worked perfectly. I could still receive calls on my normal SIM, WhatsApp didn't throw a paddy because I'd switched SIMs (as it would have done if my phone didn't have a second SIM slot), and I wasn't constantly worrying that streaming a playlist from Spotify would force my company into liquidation.

I was all set to order again from SimCorner this year, when Lebara slid

into my inbox with good news. It now had roaming bundles for the US. A 2GB SIM covering eight days would cost me a tenner; I use 3GB to 4GB most months here in the UK, so 2GB seemed plenty. There would be no faffing around with SIM cards, and I could put the saved £17.50 towards a down payment on a latte (Vegas has become unbelievably expensive).

**E**verything was hunky dory, until I got to my Vegas hotel room, fired up the Lebara app to check everything was working smoothly with the roaming bolt-on – and received a nasty shock. Despite having done nothing more than order an Uber since I'd touched down in Vegas, I'd smashed through roughly a fifth of my 2GB data allowance, according to Lebara's in-app counter. What the gibbery-flip?

I spent the next 30 minutes scouring my phone's settings, trying to find out what had downloaded so much data in the hour or so I'd been on US soil. Had I accidentally activated my phone's Wi-Fi hotspot, prompting my Mac to download an OS update or some such? No. Had the phone downloaded a large update for a game installed on my handset? No – I checked the Play Store settings but updates were still set to Wi-Fi only. Could the phone's own data counter shed any light on what had downloaded 400MB of data? No, it wasn't anywhere near granular enough to aid my investigation.

Never mind, I told my jetlag-addled self. 1.6GB should still be plenty for the rest of my week, and I'll connect the phone to the hotel's

Wi-Fi to ensure it doesn't use any more data than necessary. Except, when I log on to the hotel's network, I'm cheerfully informed I can connect only two devices, with additional clients

**“These tight, arbitrary limits that bear no relation to the cost of the data itself are maddening and should be illegal”**

incurring an extra \$15 charge. With my Mac and iPad needing to connect for work purposes, the phone would have to remain cellular-only.

**C**onsequently, I spent the rest of the week checking my Lebara data counter approximately every 18 minutes, through fear of rolling into the criminal pay-as-you-go data rates. I'd have happily bought another £10 roaming pack for peace of mind, but it wasn't clear whether Lebara would add this on to my existing data allocation or whether it would simply reset the counter at 2GB.

In the end, I just about made it through the week. With the phone not connected to Wi-Fi 23 hours a day as it is at home, I was using much more data than normal, and just stayed inside the 2GB limit. My working theory on that opening spurge of data is that Lebara's counter miscategorised my three-hour streaming session on the way to Heathrow as roaming data, because the roaming tariff was activated that day.

In 2024, this worry over data consumption shouldn't be a thing. Yes, I appreciate there's an expense to networks in supplying roaming data and hotels for providing Wi-Fi, but these tight, arbitrary limits that bear no relation to the cost of the data itself are maddening and should be illegal. As indeed they were in the EU, until Brexit gave the networks an excuse to switch on roaming rates again. The only next logical step is to go cap in hand to the USA and ask if we can become the 51st state.

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**“Despite having done nothing more than order an Uber, I'd smashed through my 2GB data allowance”**

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# Readers' comments

Your views and feedback from email and the web

## Evernote alternative

I had to write – first, to agree with the “Artful Dodger” Dick Pountain (see issue 353, p20). His excellent article rang bells with me after my recent travails with Evernote, who peremptorily announced an effective shutting down of its “free” offering at the beginning of December.

After much research I settled on Upnote. It does everything I want, quickly, and its price of 89p per month is modest. Its “lifetime” upgrade at £23 is little more than Evernote wanted for a month.

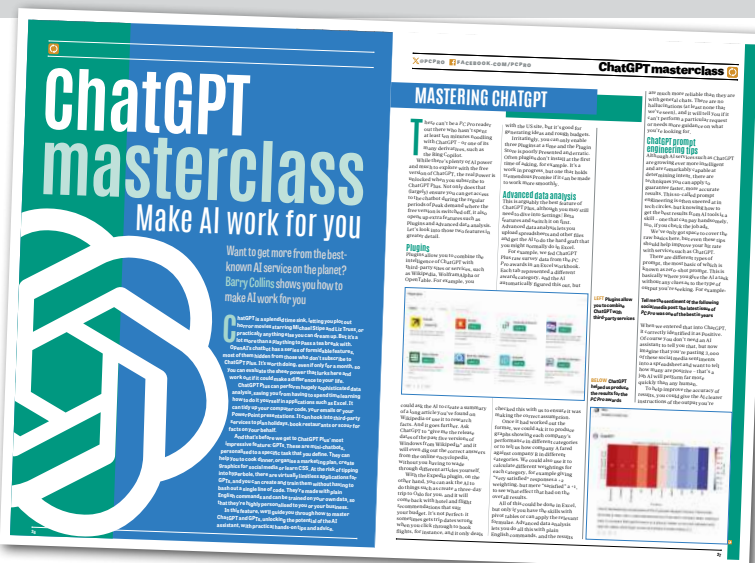
The Upnote website is excellent in design and content, answering every query I had, including a link to discussions about the team and business viability on Reddit. I was using Evernote for “projects and files” and WorkFlowy for the here-and-now, but with Upnote I could dispense with WorkFlowy – however, I’m keeping it (subject to rent-seeking) as it’s so good and simple.

My second reason to contact you was to congratulate Barry on his ChatGPT article (see issue 354, p26) – a masterclass indeed!

Andy Jupe

## Communitic 5G

I agree with Adam Jackson (see issue 353, p24) as to the abysmal mobile coverage in this country. Recently I was in Dalston, a central suburb of the metropolis, and yet even there I had a hard time getting any signal. No EE, no O2. Coverage given by the big four appears to be wildly exaggerated. Good luck trying to get a Vodafone signal travelling through the Trent Valley!



**ABOVE** Our ChatGPT masterclass last month was a winner with reader Andy Jupe

Contrast this with my recent visit to Prague. No interruptions and even a signal in the caves in the countryside! Perhaps a period of communism might assist. At least maybe we would have a functioning 4G or 5G signal after the revolution instead of the disaster we have now...

Jeff Kelland

## Never mind The Jetsons

It is undeniable that AI was the big tech talking point of 2023 and, along with humanoid robots, will surely continue to dominate headlines. However, while many people are worrying about a *Terminator*-esque cyborg uprising, I suspect the future will be somewhat less “exciting”.

As a child of the 1970s and 1980s, most futurologists back then would have had us living a life much like *The Jetsons* by now – but as we know, many things we thought would be radically different have hardly changed and, conversely, things we couldn’t have fully grasped are what changed the world completely.

My point is that while there’s some amazing work happening at the forefront of technology, there is so much still to be done on the mundane – as readers of this magazine, we no doubt all help our friends and relatives with “IT” problems and this now extends even to household appliances such as phones, TVs, vacuum cleaners and pretty much anything else electronic. If it has Wi-Fi or an app, you can be sure someone you know will need help with it.

If AI can fix this for us in the future that would be great, but as someone who used to be the only person in the house who could programme the video recorder for my parents’ TV recordings 40 years ago, I’m yet to be convinced that technology companies care enough about the mundane items that everyone could benefit from rather than the headline-grabbing sexy tech that attracts short-term attention.

Mike Webster

## Two types of data

Reading Jon Honeyball’s column in the January edition (see issue 352, p110) regarding recovering data from a failed disk, I am again reminded that there are only two types of data: that which is backed up and that which hasn’t been lost yet.

Peter Bird

## Very big Mac

Wow, the Apple Mac turns 40 years old (see issue 353, p123). I can remember the day that we were shown the first Apple Mac with its graphical user interface – it was like something from the future. At the time, I was taking a BTEC computing

## Star letter

### Problem-solving Pi

The price/performance of the Raspberry Pi 5 is amazing. In 1988, I bought an Amstrad PPC 640D with 640KB of memory and no hard disk. Arguably one of the first affordable portable, or at least “luggable”, IBM compatibles on the UK market, it cost over £600, around £2,000 at today’s prices.

The July 1993 issue of *Personal Computer World* ran a competition based on the *n*-queens problem: in how many different ways can *n* queens be placed on an *n* × *n* chess-board so that no two queens attack each other? By then, my home computer was a 25Mhz Intel 486, which solved the 17 × 17 example in an execution time of 5.7 hours. Transferring the program to a very expensive DEC Alpha workstation, which had recently been bought

by my university for high-speed scientific computing, reduced that to 25 minutes.

After 35 years, the Amstrad has come down from the loft to be sold as a historic curio: the net sale price neatly covering the £78 cost of a Raspberry Pi 5 with 8GB of RAM. Out of curiosity, I ran the same C program on this. The Pi 5 gave the solution in 29 seconds!

Chris Higley

This month's star letter writer wins a Cherry KC 200 MX mechanical keyboard, worth £80, recipient of a five-star review and a PC Pro Recommended award. Email [letters@pcpro.co.uk](mailto:letters@pcpro.co.uk)





course at my local college, where we were learning the delights of programming in COBOL using old-fashioned punch cards, and part of the debugging process was checking for poorly punched holes and real-life bugs.

It's amazing how Apple has developed and changed over that period of time, and how it has moved from being just another computer manufacturer to the leading company in the industry. And how the technology has developed to the point where a mobile phone can be as much computer as the average user requires for simple computing.

My question to you, though, is this: what will an Apple Mac be like in 2064?

Michael Ashworth



Editor-in-chief Tim Danton replies: "As someone who is terrible at predicting the future, I will leave that thought experiment to our readers!"

### Bovril in aisle 22

Nothing drives me mad more than not being able to find something in a supermarket, or finding someone to help. Why can't they have screens dotted around where you can type in, say, "bovril" and it tells you it's in aisle 22 or out of stock? So simple, and would make shopping so much easier!

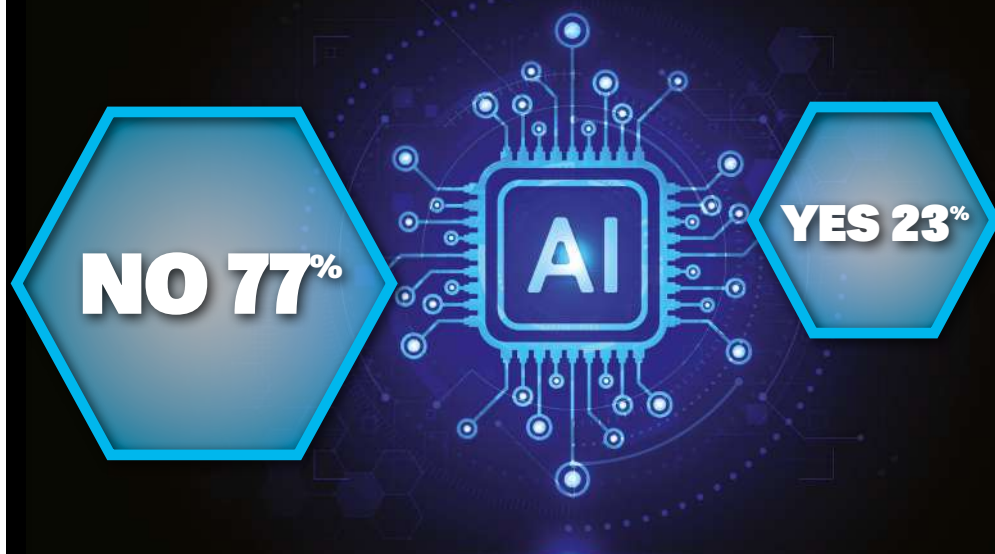
Maybe PC Pro can suggest it to Sainsbury's, Tesco, etc?

Farley David

Editor-in-chief Tim Danton replies: "While we don't tend to cover retail technology in PC Pro, there is a lot of genuinely interesting development and work going on here, including "live" point-of-sale displays and clever behind-the-scenes tech to keep the product lines moving. It can't be long before we all type that kind of search query into an app and are directed, turn by turn, to the right shelf."

## Readers' poll

We asked: do you want your next laptop or PC to include an AI chip?



If 2023 was the year of AI hitting public perception, it's now inevitable that 2024 will be the year that it lands on our PCs. Although let's not forget that Apple has had an NPU in its silicon from day one, and NPUs are no strangers to phones, either. Still, both Intel (see p46) and AMD are on a charm offensive to sell the concept of "AI PCs" to developers and end users alike.

Judging by the response from PC Pro readers on Facebook and X, that offensive needs some work. "No thanks," wrote Chris Truss. "We have just gone through the TPM thing for Windows 11 requiring new devices. Will future requirements (Windows 12) need an AI chip too?"

John O'Connell felt similarly. "No, as it would just be a way for tech companies to offload their AI processing onto people's PCs. At the moment AI is a gimmick and isn't really intelligence as such, just a glorified search engine that summarises what it reads."

"Yes," said Jonathan Henderson, bucking the trend. Or so we initially thought. "Why not be a paying beta tester for these poor unfortunate multibillion-dollar companies while they try to figure out what to do with their shiny new tech?" Our AI detects sarcasm.

But we'll end on a positive note from Graham Watts: "As someone who is experimenting and embracing Copilot, quicker local processing would be appreciated! Not sure where this pathway goes but I'm extending the life of my current kit to see where Windows and NPUs land."

“No one wants a prototype Skynet in their laptop – who knows what could happen?”

Andy Brown

“Intrigued by the idea, especially if I can add my own documents to the model completely privately.”

@eight\_ornine

“It's just summarised search, plus extrapolation and guesswork. The opposite of what this accountant wants.”

Tom Dickson

“If I want to do AI, I am quite

happy for it to be done by a central server.”

Adam Dunlop

“Hell NO. Reason? Not mature enough, especially with regard to security/privacy threats.”

Davey Winder

### Join the debate



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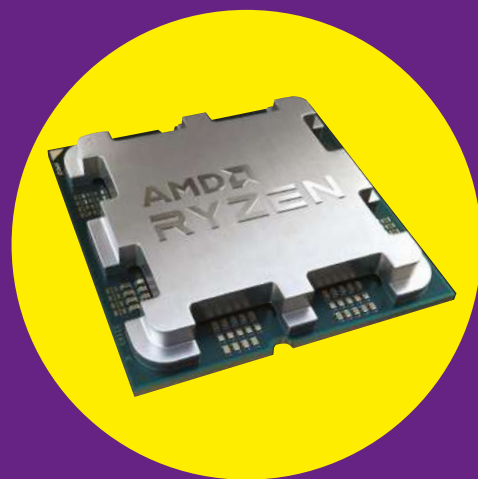
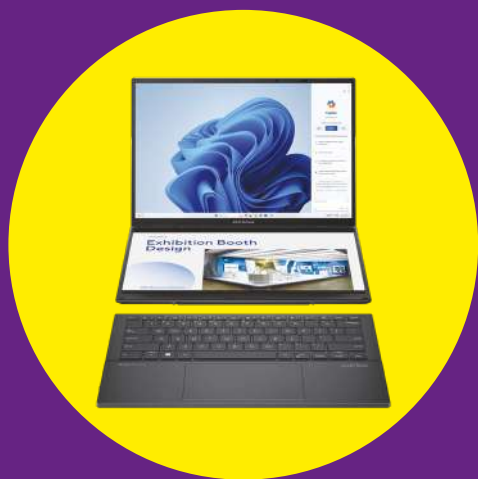
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# BEST TECH 2024

We pick the 37 standout products and new technologies from this year's CES





**W**hen it comes to future technology, no show does it quite like CES. It's the A-Z of everything electrical, with companies from Acer to Zyxel displaying their new products for 2024. But it's not just about big companies: over 1,400 startups were at Eureka Park in the hope of coverage or a distribution deal.

As you can imagine, CES is enormous. It not only consumes the halls of the gigantic Las Vegas Convention Center, it spreads out to a second convention centre – called the Venetian Expo – with three more huge halls to fill. As if that weren't enough, the show's tendrils spread into hotels across the city.

There's no hope for one person to cover this event, and even with three of us from *PC Pro* we still relied on 30 colleagues at Future Publishing – from brands such as *Laptop Magazine*, *TechRadar* and *Tom's Guide* – to help us hunt out the gems.

And those gems are what this article is all about. The fantastic products we saw at CES that will hit the streets in 2024. A handful are already on sale, most will land before summer, a few stragglers will go on sale closer to Christmas, while some are concepts that may never be seen again. We hope you enjoy our pick of the show.

**CONTRIBUTORS** Barry Collins, Tim Danton and Jon Honeyball plus Rowan Campbell, Jason England, Andrew E. Freedman, Mark Anthony Ramirez, Chris Szewczyk, Momo Tabaari and Jarred Walton





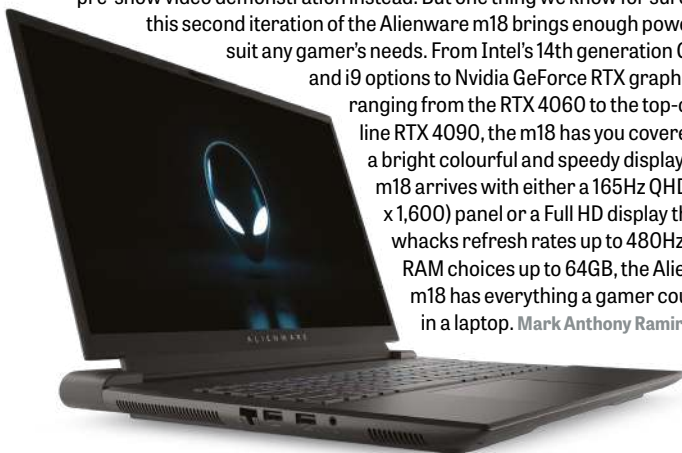


# LAPTOPS & ACCESSORIES

## Alienware m18 R2

PRICE From \$1,899 • AVAILABLE Now

We didn't get our hands on the Alienware m18 R2 at CES, making do with a pre-show video demonstration instead. But one thing we know for sure is that this second iteration of the Alienware m18 brings enough power to suit any gamer's needs. From Intel's 14th generation Core i7 and i9 options to Nvidia GeForce RTX graphics, ranging from the RTX 4060 to the top-of-the-line RTX 4090, the m18 has you covered. Need a bright colourful and speedy display? The m18 arrives with either a 165Hz QHD (2,560 x 1,600) panel or a Full HD display that whacks refresh rates up to 480Hz. With RAM choices up to 64GB, the Alienware m18 has everything a gamer could want in a laptop. **Mark Anthony Ramirez**



## Asus Zenbook Duo (2024)

PRICE From \$1,499  
AVAILABLE Late Q1 2024

On opening the laptop you'll see the Zenbook Duo has a pair of 14in OLED displays and a detachable Bluetooth keyboard that can wirelessly recharge, all of which neatly packs into an impressively slim size. It's an idea we first saw hit production in Lenovo's Yoga Book 9i, but that had a U-series CPU and an origami kickstand that left much to be desired. Improving on that design, the Zenbook Duo's kickstand is permanently attached to the laptop, and it goes up to an Intel Core Ultra 9 185H, so it should be easier to use and more powerful. The Asus model has far more ports than the Yoga, including HDMI (should two screens not do it for you) alongside two Thunderbolt 4 ports. It would seem that Asus has taken the innovations of the Yoga Book 9i and refined them into what can only be called a truly impressive piece of tech. **Andrew E. Freedman**



## Razer Blade 14

PRICE TBC • AVAILABLE Q1 2024

While Barry was smitten by the 2.5kg Razer Blade 16, which starts at £3,000 for a Core i9-14900HX, 16GB of RAM, a 1TB SSD, RTX 4070 graphics and a 240Hz OLED panel, my wallet started itching on seeing the Razer Blade 14. Of course, the sacrifice is screen size, but it offers something close to all-day battery life when you're working and gives up to RTX 4070 graphics when you want to game. All wrapped up in an all-aluminium casing that both looks and feels great. Personally, I'm more than happy to see a Ryzen 9 8945HS processor in there, too – great for games, great for AI tasks and great for multicore tasks. **Tim Danton**



## Lenovo ThinkBook Plus G5 Hybrid

PRICE TBC • AVAILABLE TBC

Lenovo restricted its ThinkPad updates at CES to refreshes of the X1 2-in-1 and the X1 Carbon (I can reveal that Gen 12 of the latter looks as tempting as ever), but it loves to take risks with its ThinkBook range. So while this is supposedly Gen 5 of the ThinkBook Plus, it's actually a radical departure. First, the lid magnetically detaches, much like Microsoft's Surface Book series. However, here the screen takes on a second life as an Android tablet (it includes its own Qualcomm processor, RAM and storage), while the base unit continues to whirr away as a Windows 11 PC.

Confused? It certainly didn't convince Barry or Jon when I tried to sell the idea on the CES special edition of the *PC Pro* podcast, but if you currently take a Windows laptop and a tablet with you on trips then this 1.7kg machine does it all. And with a super-sharp 14in OLED display and Core Ultra processor, it's a speedy, premium offering. **Tim Danton**



## Acer Swift X 14 (SFX14-72G)

PRICE From €1,799 • AVAILABLE February 2024

Acer is doubling down on the AI PC – see Barry's view on this, opposite – with the Swift X 14 (not to be confused with the Swift Go 14, which we review on p48). First of all it includes Intel's new Core Ultra H-Series processors, complete with NPUs. Second, it can be specified with up to Nvidia GeForce RTX 4070 graphics, which will come in extremely handy if you decide to generate your own AI images locally rather than in the cloud.

It will ship with Nvidia Studio graphics drivers (easily replaced by Game-Ready drivers), optimised for AI-accelerated software such as Omniverse, Canvas and Broadcast. I'll admit I wasn't blown away when I saw the chassis design – slim, grey, predictable – but I'm not going to argue with a 2.8K, 120Hz OLED display, up to 32GB of RAM and up to 1TB of SSD storage. If you embrace the AI PC concept, this may well be its peak incarnation.

**Tim Danton**



## Asus ROG Zephyrus G14 (2024)

PRICE TBC • AVAILABLE Q1 2024

This year's Zephyrus G14 has taken a sensible sidestep away from Asus' almost too strikingly bold designs towards a far more professional-looking piece of equipment. Replacing the cringeworthy AniMe Matrix design, a single slash of lighting brings a greatly refined look and feel to the equally refined aluminium shell. And while this model is upgradable to an RTX 4070 rather than last year's 4090, it more than makes up for it with a stunning OLED display and solid improvements to the keyboard and touchpad experience, increasing viability for on-the-go use without a keyboard and mouse. In fact, with these small tweaks, I would argue that the new ROG Zephyrus G14 has bigger competition in mind than simply gaming laptops. The Zephyrus G14's vibrant new screen and more professional look means the 14in MacBook Pro should be getting nervous right now. **Jason England**



## Lenovo Mechanical Energy Harvesting keyboard and mouse

PRICE TBC • AVAILABLE TBC (if ever)

I'll be honest – when Lenovo trailed the idea of a mechanical “energy harvesting” keyboard, I thought this Bluetooth device would somehow capture the energy from my heavy-handed typing and save me from ever charging a keyboard again. Not quite. Instead, the company's keyboard has a solar strip running across the top, capturing any ambient light that might be available. If that's not enough, you can flip the keyboard over and turn a mechanical crank, although five minutes of spinning that wheel will power the keyboard for a mere 30 minutes. The crank on the mouse does likewise.

We all want greener peripherals, but I'm not sure these are the answer. **Barry Collins**



## Dell XPS 16

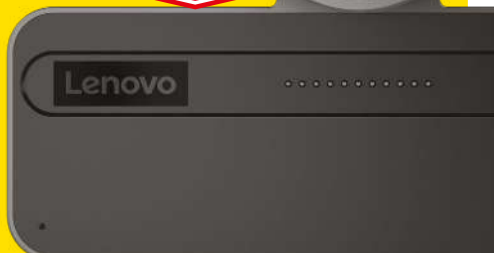
PRICE From \$1,899 • AVAILABLE Q1 2024

Officially, Dell wasn't at CES. The only places to find its wares were on AMD and Intel's stands. But that didn't stop the company from releasing new products to coincide with the show, and the XPS 16 was arguably the best of them all. From its sleek design, beautifully responsive keyboard and Full HD (1,920 x 1,080) 120Hz and 4K (3,840 x 2,400) display options to its choices of Intel Core Ultra CPUs, the XPS 16 is a masterclass in producing a laptop with both productivity and performance in mind. With GPU options ranging from Intel's integrated Arc graphics to Nvidia GeForce RTX 4070, and up to 4TB of SSD storage, I can't wait to get my hands on a review unit. **Mark Anthony Ramirez**

## Lenovo Magic Bay Studio

PRICE \$200 • AVAILABLE April 2024

The Studio webcam is only one of a series of Magic Bay accessories that Lenovo could launch this year. Magic Bay lets peripherals attach magnetically to the back of the laptop lid, and working Lenovo prototypes shown at CES include a (rather chunky) SSD and a 10in screen to complement the main display. With USB-C ports at a premium on most modern laptops, it's a convenient way to attach peripherals without wasting ports. The Magic Bay Studio is a 4K camera that should offer much better video quality than the laptop's tiny integrated cam, and it also includes a pair of 2W speakers to work in harmony with the laptop's own and boost the sense of spatial audio on video calls. Alas, this concept is currently restricted to selected laptops in Lenovo's ThinkBook range. We'd love to see it adopted by other manufacturers to supercharge a market for third-party Magic Bay peripherals. **Barry Collins**



## SHOULD YOU BUY AN AI PC THIS YEAR?

With chip and PC makers desperately searching for something to rouse the industry from its post-pandemic slump, the AI PC is their big hope. Essentially a regular PC with a neural processing unit (NPU) inside to handle AI workloads locally, companies including HP, Lenovo and Dell are bullishly predicting a surge in sales. Should you jump in?



No, not yet. It's early days for NPUs and nobody seems quite sure what to do with them yet. There are a lot of prototype demos, much talk about running AI services locally instead of the cloud, but little in the way of concrete benefits to leaping in at this stage. Not unless you're particularly desperate to have a Windows Copilot key on your keyboard (narrator: nobody was desperate for a Windows Copilot key).

Much will hang on what Microsoft delivers with Windows 12. Heavy hints were dropped during CES that Microsoft is refactoring the next version of Windows to handle more of its AI tasks locally rather than sending everything to the cloud. With Windows 12 expected to arrive in the second half of this year, it would certainly seem wise to wait.

Microsoft over-promised on Windows 11 Copilot, but if it can finally deliver the AI features it trailed (such as full integration with third-party apps) then Windows 12 really could be a reason to invest in new hardware.

Certainly, if you're forced into replacing a PC before Windows 12 arrives, you should look for one with an NPU included. It would be no surprise if Microsoft included NPUs in its system requirements for Windows 12, meaning you've (hopefully) future-proofed your investment. But until the benefits become clearer, the AI PC revolution can wait.

**BARRY COLLINS**





# CPUs

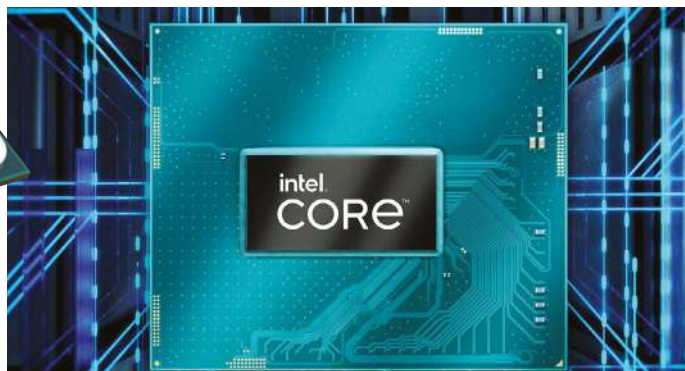
## AMD Ryzen 5 8600G and Ryzen 7 8700G

PRICE 8600G, £220; 8700G, £310

AVAILABLE Now

AMD rolled out its Ryzen 8000G lineup of APUs at CES 2024, beating Intel to the punch as the first company to bring purpose-built AI accelerators to the desktop PC. As we've seen in the past, AMD builds its APUs for the desktop using the same silicon as its laptop chips. In this case, AMD uses the "Phoenix" architecture that employs the Zen 4 CPU architecture and RDNA 3 graphics engine. However, the lack of battery life concerns in desktop PCs allows the chip to run at higher power limits, thus unleashing the full power of the silicon. AMD's two flagship models, the Ryzen 7 8700G and the Ryzen 5 8600G, boast eight and six cores respectively.

AMD also brought its new APU lineup up to modern standards with support for AM5's DDR5 and PCI-E 4 connectivity. AMD's APUs have historically dominated the entry-level gaming market as Intel doesn't have processors with powerful enough integrated graphics to provide meaningful gaming performance, even for low-end gaming systems. Here, AMD claims it delivers 1080p-capable gaming performance, even in some AAA titles, albeit at reduced settings. With competitive pricing and bundled coolers, the new Ryzen APU models are poised to dominate the entry-level gaming segment once again. **Paul Alcorn**



## Intel Core 14th Gen HX-series

PRICE Not applicable • AVAILABLE Now

With all the AI razzmatazz surrounding the launch of its Core Ultra processors (see p46), it's perhaps surprising that Intel chose CES as its launchpad for what must be the last hurrah of its traditional Core chips. The HX-series sits right at the top of the line, above the Intel Core Ultra H-series, with 24 cores and Turbo clocks up to 5.8GHz. That compares to 16 cores and a 5.1GHz peak for the Ultra H-series. So, you may ask, why release it at all? Intel argues that it has produced the world's fastest mobile processor, one that can be overlocked and will perform better in multicore scenarios. The downside (other than its high price) is that HX-series chips require thicker chassis to keep them cool, so you'll find the CPUs in gaming laptops such as the Asus ROG Strix Scar (see p54) rather than traditional designs. **Tim Danton**

## Intel Core 14th gen desktop CPUs

PRICE From £115 • AVAILABLE Now

Intel released the overclockable, high-end K series of 14th generation desktop Core processors in October last year, and while they're all solid chips we found little to shout about in our reviews (see issue 351, p46). This isn't surprising, as they're based on the same Raptor Lake design as 13th generation chips, but with minor clock increases. At CES, Intel announced the full 14th gen lineup, from the Core i3-14100F (£115) to the Core i9-14900 (£570). These are mainstream CPUs, with no overclocking capability, with even Intel's benchmarking suggesting a modest 3% to

4% increase in speed compared to 13th gen Core desktop chips. The star of the releases is the Core i7-14700, which, thanks to four additional E-cores, has 12 cores compared to the eight of the i7-13700. **Tim Danton**



## AMD Ryzen 5000 series update

PRICE From £120 (5500GT) • AVAILABLE Now

It didn't garner many headlines, but AMD also refreshed its AM4-based Ryzen 5000 platform at CES. Four new chips join the party: the Ryzen 5 5500GT, Ryzen 5 5600GT, Ryzen 7 5700 and the gaming-focused Ryzen 7 5700X3D. The idea is to give users of older AM4 boards the chance to boost their speeds without throwing away the platform they've built.

The GT suffix indicates that the chips have six Radeon cores built in, giving, AMD claims, a boost of anything from 3% (Far Cry 6) to 10% (PUBG) in games, and 6% (Cinebench multicore) and 11% (WinRAR) in applications compared to the 5600G. **Tim Danton**



# NPU & AI

## DeepX DX-V1

PRICE Not applicable • AVAILABLE Now

At the DeepX stand, I chatted to Ha Joon Yu, an IP specialist at the South Korean AI chip-maker. It was displaying three of its NPUs, which are built into M.2 format devices so they can be easily added to, for example, single-board computers.

The DX-V1 (pictured) detects people and objects in tandem with a camera. Was he worried about the rise of NPUs in chips from AMD and Intel? "Intel, AMD and Qualcomm... have to have an AI function built into their microprocessor, because this market is very big, but this market is also very fragmented."

"There are very huge markets, like AI PCs, AI smartphones, and that's what Qualcomm, Intel and AMD will do. But we want every data to be analysed or handled at the edge, that's what we have done. It reduces the cost, and it reduces power consumption." **Tim Danton**

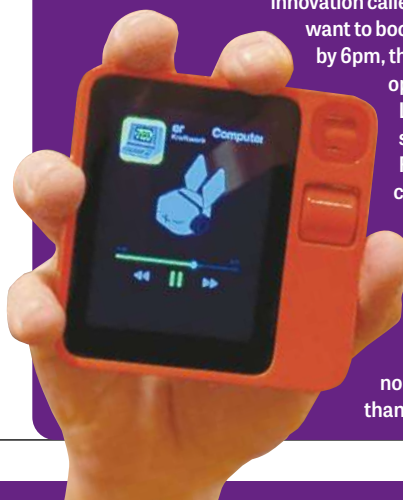


## Rabbit r1

PRICE \$199 • AVAILABLE Pre-order now

With just an LCD screen, camera, scroll wheel and a button, the pocket-friendly Rabbit r1 is nothing special to look at (if you ignore the neon orange casing). But go down the proverbial rabbit hole and you'll find a lot more hiding behind the retro design.

The Rabbit r1 works as the next step up from Siri or Google Assistant, able to understand natural language requests thanks to a ChatGPT-style LLM voice assistant. It can break down and perform those tasks thanks to a "breakthrough" innovation called the Large Action Model. For example, if you want to book an Uber to get six people to a restaurant by 6pm, the r1 will hook into the Uber API, look for options and present the choice back to the LLM. The user can then press a button on the screen to confirm the ride. You can teach the Rabbit new tricks by using the camera to capture you interacting with the service. A practical example is learning to add information to a spreadsheet. The r1 isn't designed to be a replacement for a phone, but as a companion. The makers claim "it can do some things better than a phone and much faster". And at just \$199 and with no subscription, it's a cheaper long-term option than subscribing to an AI service. **Ryan Morrison**





# PCs & COMPONENTS



## Nvidia GeForce RTX 4070 Super

PRICE £579 • AVAILABLE Now

With the Nvidia RTX 4070 Super, you're essentially getting about 93% of the RTX 4070 Ti for 75% of the price. Alternatively, you're getting 22% more GPU than the RTX 4070 for the same price. More importantly, you're getting 12GB of high-speed GDDR6X memory, along with access to Nvidia's RTX technologies: DLSS 3, superior ray tracing and AI tensor cores. Given the RTX 4070 already trades blows with the RX 7800 XT – slightly slower rasterisation performance, much faster ray tracing and AI performance, and the RTX 4070 Ti does the same with the RX 7900 XT – Nvidia now effectively delivers a higher performance option at the same price. Read our full review on p68. **Jarred Walton**

## Asus ROG NUC PC

PRICE TBC • AVAILABLE TBC

Asus finally unveiled its long anticipated NUCs at CES 2024, with the NUC 14 Pro and NUC 14 Pro+ sitting alongside this gaming version. Following in the footsteps of Intel's now discontinued NUC gaming PCs, this first Asus ROG NUC is a great indicator that the future of mini gaming PCs is in good hands. The Asus ROG NUC will come with two configurations. The first features an Intel Core Ultra 7 155H and an Nvidia RTX 4060 laptop GPU, while the more powerful version packs in a Core Ultra 9 185H and RTX 4070. Both versions fit snugly into the 2.5-litre chassis, which can be positioned vertically or horizontally, and will be equally at home plugged into a TV or sitting comfortably on a small desk.



It includes six USB-A ports, plus a Type-C port with Thunderbolt 4 support, Ethernet, HDMI 2.1 and DisplayPort 1.4 outputs. An SD card reader and 3.5mm audio jack round things out, along with Wi-Fi 6E. That's a capable set of connectivity options on such an already versatile device.

Chris Szewczyk

## MSI Project Zero

PRICE From around \$200 • AVAILABLE Q1 2024

If you're the kind of person who hates seeing cables but loves building PCs, then you may well find yourself buying an MSI motherboard this year. That's because its Project Zero boards are designed with precisely you in mind: storage and power are handled behind the scenes, leaving the user-visible side of the motherboard for the graphics card, RAM and CPU. By no coincidence, the components that are riddled with RGB fans in many gaming setups.

When I asked the MSI rep how much this would all cost, I prepared myself for a hefty figure. But with prices for the boards from \$200, MSI Project Zero is well within the reach of keen gamers. Nor is MSI forcing you to buy its own cases, with examples from Origin and Corsair on show. One final benefit: not only will your PC look good, but working in a cable-free chassis makes it far easier to access the core components of your PC when it's time to upgrade. **Tim Danton**



## AMD Radeon RX 7600 XT

PRICE £330 • AVAILABLE Now

What's the difference between the RX 7600 XT and the RX 7600? An extra 8GB of GDDR6 VRAM and £60! Not the best joke you'll hear this year, so let's quickly move on and explain why you might want one. In short, it's about playing games at max settings, where memory matters. AMD claims that *Forza Horizon* at 1440p, RT Extreme settings, jumps from 56fps to 81fps (with FSR 2 active). More normally, it promises a 10% jump in games at 1440p peak settings – *Starfield* is up from 53fps to 60fps, for instance. But we'll wait until we put it through our tests before making a firm conclusion. **Tim Danton**

## MSI Claw

PRICE From \$699 • AVAILABLE H1 2024

One way to make a splash at CES is to be the first to do something. And while the MSI Claw isn't the first modern handheld gaming PC, it is the first mainstream PC brand to use Intel Core Ultra processors (or to use Intel at all, with all its competitors in the field opting for AMD chips).

It also packs a bigger battery than other handhelds, even if MSI isn't exactly claiming record-breaking battery life at a mere two hours. MSI claims that it's producing a more ergonomic device than rivals, though, and while the plastic shell is a controversial choice, the real test will come with long-term use. What may make the difference and help MSI come out on top is its App Player, an app present in many of MSI's gaming laptops that is capable of running software from the Google Play Store. Which, presuming that the MSI Claw will come with similar compatibility, could prove to be an excellent way to play mobile games on the go. **Andrew E. Freedman**





# DISPLAYS

## Xebec Snap

PRICE \$999 for two screens • AVAILABLE Now

Portable screens for laptops have become something of a CES staple in recent years, but the Xebec Snap adds a touch of refinement to juggling multiple displays.

With this system, you can "snap" a screen to either side of the laptop's main display, which is held in place by strong magnets. If you want to switch the orientation of either screen, you just pull it off and rotate it, giving you a range of orientation choices.

The Snap is available in one or two-screen configurations, with each display a 13.3in Full HD model with a claimed 400cd/m<sup>2</sup> of brightness. The company plans to extend the system further with more snap-on accessories, including a wireless smartphone charger and a bright light to help you look your best in video meetings or streams. The two-screen configuration (confusingly called Snap Tri-Screen as it includes the laptop's own display) costs \$999, while a single extra screen (Snap Dual-Screen) costs \$549. **Barry Collins**



## Alienware 32 4K QD-OLED

PRICE \$1,199 • AVAILABLE Now

The Alienware 32 4K QD-OLED is one of the best monitors of CES 2024, if not the best. Billed as the world's fastest 4K OLED monitor, the Alienware 32 makes any game you're playing look and run at its best. Minute details come through in crystal clarity thanks to the panel's 140 pixels per inch, which is the highest of any existing OLED gaming monitor (most max out at 100ppi). Alienware claims the display can achieve 99% of the DCI-P3 colour gamut, which accounts for the lush colours. On top of that, the 240Hz refresh rate and 0.03ms response time ensure games play buttery smooth. If you're like me and loved 2022's Alienware 34 QD-OLED, you're going to adore the new Alienware 32. **Tony Polanco**



## Mobile Pixels Geminis Studio

PRICE Around \$800 • AVAILABLE 2024

"Let them eat screens" could have been the motto of CES 2024, with almost every stand seemingly intent on thrusting more displays in our faces. The Geminis Studio from US firm Mobile Pixels was one of the more interesting displays. Or should we say two displays, because this beast is a dual 27in display that's vertically hinged.

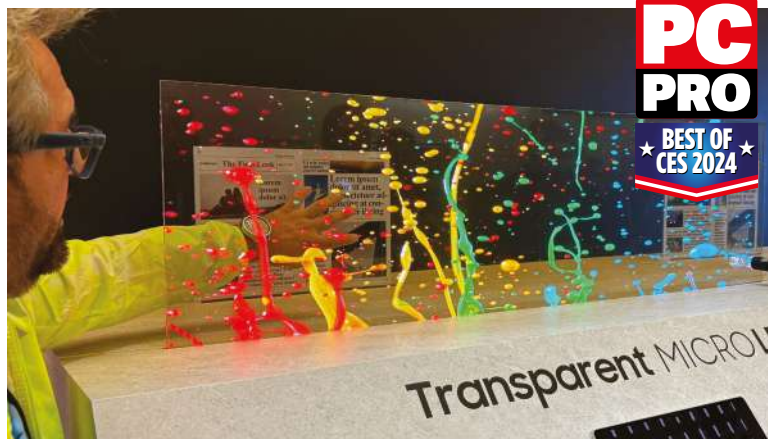
That allows you to use the bottom display in easel mode, drawing on the screen with a compatible stylus. When the drawing is done, you can push it flush and have two 4K displays stacked atop one another, giving you plenty of screen space to work with. If you're thinking that seems familiar, you're right: we reviewed the non-touch predecessors, the plain Geminis, in issue 352 (see p65).

The updated screen is yet to launch, but is expected to cost around \$800, and we expect Scan to ship the new model alongside the existing one. Keep an eye on [mobilepixels.us](https://mobilepixels.us) for launch details. **Barry Collins**

## Samsung MicroLED transparent display

PRICE N/A • AVAILABLE TBC

Is it January, says Samsung to itself? Then it must be time to unveil our latest TV and display technology at CES! It was no different this year, except in its ongoing war with the competition Samsung opted for an entirely transparent panel. Think of a window that's also a TV screen. It's quite amazing to look at, with a huge wow factor. (And I'm not easily wowed.) The question, as always, is whether this can be brought to market for a reasonable price, and how well it will work in practical implementations. However, there are obvious use cases, such as transparent front windows for high-end shops, whereby products and adverts can be shown while still allowing a view into the store itself. Although, if the price is right, I might be tempted to have a kitchen window outfitted with this. **Jon Honeyball**





## AUDIO



### Auracast Bluetooth

PRICE N/A • AVAILABLE Now

You're sitting in the pub, trying to watch the rugby, while all around you are engrossed in the football and its commentary belting through the speakers. It's hardly Twickenham, is it? But Auracast could soon make that experience more bearable. Pleasant, even.

With this new Bluetooth technology, venues will be able to broadcast multi-channel audio to as many customers as they can hold. You could hook your Bluetooth headphones to the rugby commentary, while others listen to the football. Conference centres could provide live translations of speeches being given on stage, with audience members able to select their language.

The technology will even work at a local level, with you able to share your laptop's audio with other headphone wearers in the vicinity, instead of having to split earbuds between you. It's going to need hardware support, but Auracast should be arriving in headphones, speakers and smartphones as the year wears on. **Barry Collins**

### Sennheiser Momentum True Wireless 4

PRICE £260 • AVAILABLE Pre-order, 15 February

While I'll wait for the Honeyball verdict on audio quality – perhaps on a *PC Pro* podcast this spring – my early testing suggests these are a rival for the very best earbuds on the market. Listening to “Englishman in New York” was a pleasure, with the drums and vocals coming through perfectly in a busy environment thanks to active noise cancelling, Qualcomm's S5 Sound Gen 2 platform and a 42mm diameter. Ultra-low latency bodes well for AR lovers, too. They also fitted snugly and comfortably in my ears, making them a rarity for true wireless earbuds in my experience.

Sennheiser released two other products at CES. The Accentum Plus slots into the mid-range for ANC headphones at £200, while the £260 Momentum Sport earbuds include a heart-rate and body temperature sensor to effectively replace the heart strap for athletes. **Tim Danton**



## AR



### Canon Free Viewpoint

PRICE N/A • AVAILABLE N/A

Trailed at last year's CES, we finally got a chance to test Canon's Free Viewpoint VR system at this year's show. In a nutshell, Canon has teamed up with the NBA to capture basketball games and replay the action in VR. With a surface the size of a dining table in front of you, the VR headset allows you to watch the slam dunks and other action as if it were taking place right in front of you, in pseudo 3D.

The resolution and frame rates need improvement, but could this be the future of watching sport? Hell, yes. It even made basketball look interesting for ten minutes. There are all manner of challenges to overcome before this translates to watching games live however, not least the huge amount of bandwidth it requires. **Barry Collins**



### Xreal Air 2 Ultra

PRICE £699 • AVAILABLE Now

AR glasses were something of a spectacle at CES 2024, with dozens of stands thrusting a pair of goggles into your face. We didn't come across any better than the Xreal Air 2 Ultra, though. This new set of Xreal specs adds hand tracking, meaning you can point at interface items and “click” your thumb and forefinger together to open them. This is all held together by Xreal's custom interface, which makes it simple to play videos, stream music or interact with friends.

The 80g glasses are nowhere near as heavy or all-encompassing as the Apple Vision Pro headset, but you can press a button on the side to toggle background transparency levels to put you back in the room. Resolution is decent at 1080p in each eye, and a 120Hz refresh rate will please most gamers. The drawback is that the “spatial computing” features currently only work with limited Samsung S22 or S23 handsets, but screen mirroring is available for the full gamut of PCs, Macs, phones and consoles. They'll cost £699 after the initial launch discount. **Barry Collins**



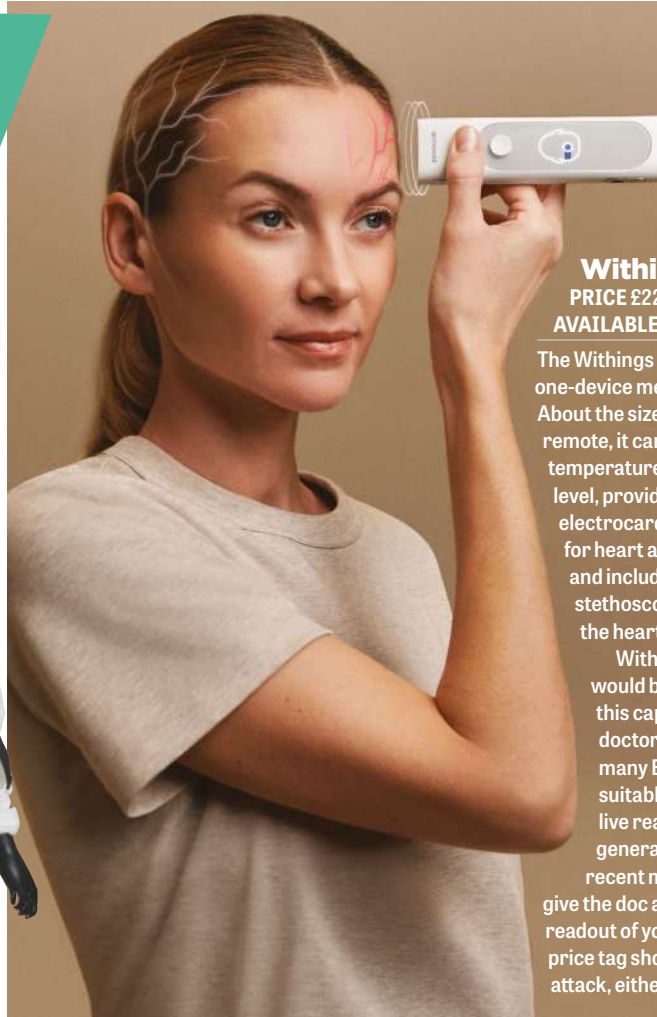


# ASSISTIVE & WELLNESS

## Ximira PHINIX

PRICE TBC • AVAILABLE TBC

Some of the most exciting uses of AI and machine vision is in the area of support for people living with disabilities such as blindness. Ximira is working on a platform called PHINIX (Perceptive Helper with Intelligent Navigation and Intuitive eXperience), which currently looks like an enhanced backpack. A Framework laptop motherboard and storage sit inside, wrapped in a plastic case, with cameras mounted on the backpack's straps plus headphones for the wearer. PHINIX uses AI to recognise the scene around the user and to describe it clearly – alerting you to pedestrians and street furniture, for example – and it can also use facial recognition to identify nearby friends. It's early days for this project, but the potential is significant. **Jon Honeyball**



## Withings BeamO

PRICE £220

AVAILABLE H1 2024

The Withings BeamO is a one-device medical check-up. About the size of an Apple TV remote, it can measure your body temperature, your blood oxygen level, provide a "medical-grade" electrocardiogram to check for heart abnormalities, and includes a digital stethoscope for listening to the heart and lungs.

Withings reps claimed it would be easy to share all this captured data with your doctor, although we doubt many British GPs are suitably equipped to take its live readings. Still, it can generate a PDF of your recent metrics, if you need to give the doc a less high-tech readout of your results. The £220 price tag shouldn't induce a heart attack, either. **Barry Collins**



## Baracoda BMind

PRICE TBC • AVAILABLE TBC

Looking like something straight out of a sci-fi movie, the BMind smart mirror could well be a glimpse into the bathrooms of the future. Powered by generative AI, it offers personalised recommendations based on your mental state, all read by a built-in camera that can read facial expressions (and remember individuals, to keep user history private).

For example, by sensing that you're feeling down, it can use a series of light therapy techniques or run suitable mindfulness exercises – all provided through Baracoda's CareOS interface and programs from ThrivePal. It can also offer physical assistance with tools such as guided toothbrush coaching, while skin analysis means it can make recommendations for how to, say, reduce redness in your face (or increase it, should you be looking Snow White). If it works as well as BMind claims, it could prove to be the next step in the evolution of virtual assistants. And hopefully not the start of an episode of *Black Mirror*. **Rowan Campbell**



## EssilorLuxottica Nuance Audio

PRICE N/A • AVAILABLE H2 2024

EssilorLuxottica is a big name (in every way) in eyecare, owning a retail network of 18,000 stores across 150 countries, including Vision Express in the UK. Last year it snapped up Nuance Hearing, and this is the result: a pair of glasses developed to help those with "mild or moderate hearing loss".

Say you're in a restaurant: the front-mounted cameras will detect who you're looking at, with the Nuance-developed algorithms then amplifying and enhancing the speaker's voice. The result is discreetly beamed straight into your ears via speakers mounted into the stems. It's a clever concept, and it did work when I tried them on in the demo, but I would warn against expecting miracles. But you can try them for yourself later this year. **Tim Danton**



# RANDOM



## Swarovski AX Visio

PRICE £3,820 • AVAILABLE February 2024

It seems like AI is trying to sneak into everything these days, wanted or not, but in this case I think it may actually belong. You can use these high-end binoculars not only to take digital photos with, but also identify what you're looking at using AI recognition software. The neural processing unit in these binoculars is similar to what you get in the latest phones, and has been trained to identify 9,000 species of birds, making bird-watching more accessible to the layman than ever. Simply look through the AX Visio like any other pair of binoculars, and when you see a mystery bird, press a button on the side that will show a red circle in your vision. Get your bird into this circle, and its name will appear underneath. While the product itself is amazing, it does lead me to wonder whether there are in fact birdwatchers out there who are willing to dish out nearly £4,000 on a pair of binoculars that would need the birds identified for them. Rowan Campbell



## Clicks Keyboard

PRICE \$139 • AVAILABLE Now (some models)

It's almost impossible nowadays to find a modern smartphone with a real physical keyboard, but from what few devices are available it's even harder to find a high-end product in that range. It's that gap that Clicks aims to fill. If you write a lot of messages, miss the tactile feeling of a proper keyboard or even if you're just sick of typos, Clicks gives you a smart new way to type that notably frees up a ton of screen space and creates new handy shortcuts to use.

It fetches quite the price at \$139, but matches the price by offering a premium feel for your iPhone. The case itself has a backlight, and it comes in a London Sky blue or in a striking BumbleBee yellow that will be sure to attract glances from curious keyboard newbs and old-school BlackBerry fans alike. The case Clicks is making for the return of physical keyboards is strong, but

at such a hefty price I'm not sure that the premium branding will be enough to sell it to the wider market of Apple users who aren't just in it for the nostalgia factor. Rowan Campbell

## Custo Smart Mailbox

PRICE From €1,299

AVAILABLE Now

A big black box in the middle of the showfloor? How could I not stop to chat, and I'm glad I did as this is exactly what I'm looking for. Think of the Custom Smart Mailbox as Amazon Lockers but for a small collection of houses, much like my cul-de-sac, in fact. It asks couriers to scan the barcode on their package; then the door opens and it can be securely dropped. From the barcode data, Custo informs the supplier that the item has been delivered.

Ideally a company such as Ring would have such a unit to go along with its smart doorbells, but for the time being Custo might be the answer. It's not cheap at €1,599 for the larger, chest-high unit and €1,299 for the smaller one, but that's an affordable price for a cluster of homes to buy together. Jon Honeyball



## Aegis Rider

PRICE Not stated • AVAILABLE Summer 2024

Putting a heads-up display in the eyeline of a motorbike rider has been a long-term goal of many vendors. BMW, famous for its motorbike division, showed a HUD facility some years ago, but it never came to market – perhaps because putting fixed hardware that close to the rider's eyes is a safety hazard. However, Aegis Rider is working to fix that problem, offering a full HUD display that can be either mounted directly within the helmet or mounted on smart glasses that are worn within the helmet. The company told me it would have product ready to ship in the summer, although the price won't be cheap. Nevertheless, such capabilities will have a market, and maybe it's time for the mainstream vendors to look at this area again. Jon Honeyball

## Unistellar Odyssey and Odyssey Pro

PRICE From £2,199 • AVAILABLE Now

How many people have telescopes tucked away in the loft because they simply couldn't find anything interesting to gawp at in the night sky? The Unistellar Odyssey and Odyssey Pro aim to eliminate that struggle by using an accompanying smartphone app to automatically point the telescope at that night's essential viewing, even displaying the results on your smartphone/tablet screen. If you want to view the action directly, the Odyssey Pro comes with a conventional telescope eyepiece, although we found it a little small. Improved optics in this model should make it easier to see both planets and deep sky objects such as nebulae from the Odyssey, even in light-polluted inner-city areas. At £3,499 for the Pro model or £2,199 for the plain Odyssey, let's hope there's plenty to look at, as you won't be able to afford a night out for a while. Barry Collins

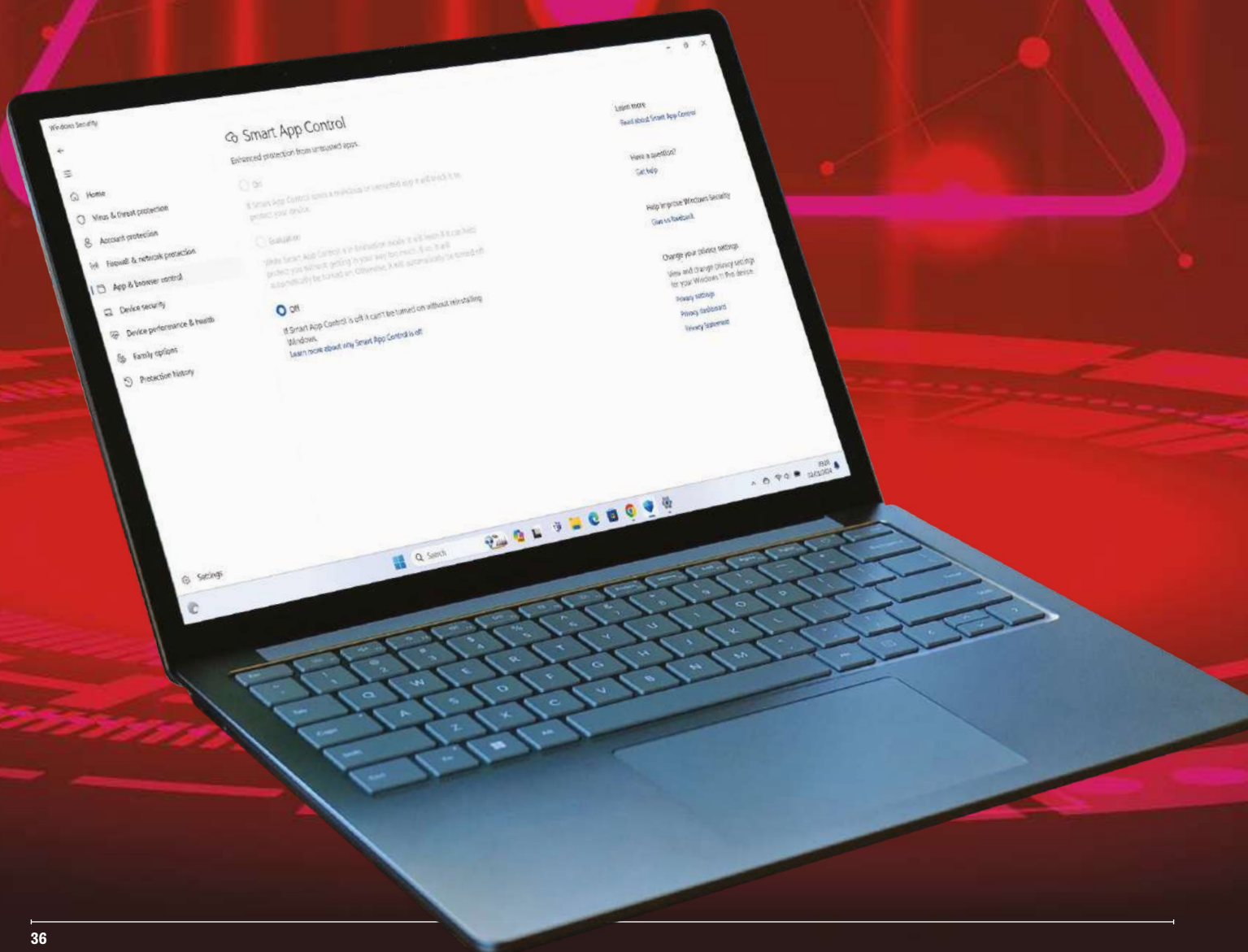






# Boost Windows' defences

Darien Graham-Smith explains how to get the most out of Windows Defender and Microsoft's other built-in tools



**I**t runs on almost every Windows PC, but what exactly does Windows Defender do – and what settings should you be tweaking for the best protection? Here, we reveal seven tips that not only explain the philosophy (and history) behind Windows Defender, but also how to get the most out of it.

## 1 What is Windows Defender?

It's a funny thing: everyone's heard of Windows Defender, but if you search your system, you won't find any program of that name. At least, not if you're running a recent version of Windows 10 or 11.

For more than a decade, though, the OS did include a built-in tool called Defender. In Windows Vista and 7, Defender was a system component that detected and removed spyware from your system; in Windows 8 it was upgraded into a one-stop integrated defence against all types of malware, replacing the optional Microsoft Security Essentials antivirus tool.

Today, Defender has lost its individual identity. Windows 10 introduced a whole spread of new security features, including protection against OS vulnerabilities, intrusion prevention and anti-ransomware measures. And to house all of these new features, the new Windows Defender Security Center was created. The Defender app was replaced by a few pages of buttons and drop-down menus, headed "Virus & threat protection", inside this central Security console. And in the October 2018 update the Defender branding was dropped completely; the app is now known simply as Windows Security.

The Defender name does persist in a few places, however. In the legacy Control Panel interface, the firewall is still referred to as the "Windows Defender Firewall", and as we'll discuss below, the name has been co-opted for various add-on apps and features.

While Defender may have dropped out of sight as a standalone system component, its antivirus engine is still present in the latest versions of Windows, keeping you safer than ever. It just leaves us in a situation where no-one is really sure how to refer to the antivirus component any more: security specialist AV-Test.org continues to refer to Windows Defender, while others such as AV-Comparatives.org and SE Labs UK call it Microsoft Defender Antivirus.

## 2 Windows Security is (probably) all you need

Those security labs specialise in comparative security testing – and they'll all confirm that, in its early days, Windows' native antivirus protection wasn't worthy of the name. As recently as 2018, testers were criticising Defender's mediocre protection, alarming false-positive rate and considerable impact on overall system performance. In issue 291 of *PC Pro*, published in late 2018, we even ran an 18-page Labs roundup of security suites under the headline "Dump Windows Security now".

That sort of reputation is hard to shake. If you frequent online advice forums today, you'll still see plenty of people rubbishising Defender. But in fact Microsoft has turned things around in recent years. In AV-Test's latest product roundup, Defender was named a "Top Product" ([tinyurl.com/354avtest](https://tinyurl.com/354avtest)), while AV-Comparatives gave Microsoft a two-star protection award – on par with big names such as F-Secure and Norton ([tinyurl.com/354avcomp](https://tinyurl.com/354avcomp)). SE Labs gave Defender a triple-A rating, reflecting perfect protection against malware with zero false positives ([tinyurl.com/354selabs](https://tinyurl.com/354selabs)). In our last Labs test (see issue 343, p85), Defender earned a five-star rating, not only for protection but usability as well.

There are still reasons to choose a third-party security alternative. Independent suites normally include bonus features such as password managers or VPNs, and they're often more user-friendly than Windows Security. However, as our Labs contributor KG Orphanides concluded last year, "for most users concerned about how to best keep Windows safe, Defender does the job as well as anything else".



## 3 Always up to date

One of the big challenges for antivirus software is "zero day" threats – real-world attacks that exploit previously unknown vulnerabilities. When a zero-day is discovered, the race is on to update everyone's security as quickly as possible and minimise the damage.

That alone might seem like a good reason to steer

clear of Defender. Famously, Microsoft only rolls out major security updates once a month, on "Patch Tuesday" – and while you'll sometimes see antivirus signature updates sitting in the regular Update queue, most of us don't make a habit of installing these items manually.

Thankfully, you don't need to. If you don't manually install them, Windows

**If you frequent online forums today, you'll still see plenty of people rubbishising Defender. But in fact Microsoft has turned things around in recent years**

**BELOW Microsoft issues security updates multiple times every day**

silently installs the latest malware signatures at least once a day. You don't get notified when this happens, simply because you'd be facing a continual procession of interruptions: for example, on Christmas Day 2023 (to pick a date at random) eight new security updates were released.

If that's not reassuring enough for you, Windows also includes a feature called "cloud-delivered protection". You can check it's enabled by opening the Virus & threat protection page in the Windows Security app and clicking the "Manage settings" link.

By default, cloud-delivered protection follows a rule called "block at first sight", which means any unrecognised files are automatically uploaded to Microsoft's servers for immediate analysis before they're allowed to run on your PC. You're protected even against previously unseen dangers – and if Windows suspects a file may contain personal information, you'll be prompted to permit cloud processing before anything is transmitted. If you prefer not to have anything sent to Microsoft, just turn off the switch labelled "Automatic sample submission".







## 4 Turn on ransomware protection

Ransomware is a huge threat to big businesses and personal PCs alike. It's important to protect your irreplaceable family photos and personal documents, because if you do get hit the ransom demand could run to thousands of pounds.

Hopefully, any ransomware attack should be caught by Windows' antivirus scanner. Windows also encourages you to back up your personal files to OneDrive, where they're safely stored in the cloud, and can be rolled back to previous versions if they're tampered with.

What you may not realise is that Windows Security includes an additional feature that can completely block ransomware before it strikes. Controlled Folder Access prevents any applications from writing to your personal folders – except for programs pre-approved by Microsoft, or manually authorised by you. Even an app running with administrative privileges can't change or delete your data without your approval.

Controlled Folder Access was introduced to the Windows Security Center back in October 2017 – but sadly it's always been turned off by default. You can enable it by opening the Virus & threat protection page of the Windows Security app, clicking the Ransomware protection link and flicking the switch for Controlled folder access.

Once you've done this, you'll see three new links appear, labelled "Block history", "Protected folders" and "Allow an app through Controlled folder access". We recommend you click to review your protected folders, to see which locations are being monitored – and add any extra folders you might want to protect, such as external drives or network storage.

With this done, ransomware should hold no fear for you. However, Controlled Folder Access can interfere with legitimate programs (which is probably why Microsoft doesn't enable it by default). If this happens, you'll see a pop-up alert; click on this to open the Controlled Folder

Access settings and review what's been blocked. If it's something you recognise and trust, click Actions and select "Allow on device" to unblock the affected app.

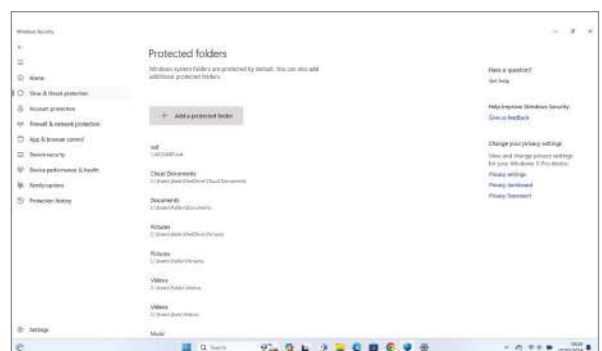
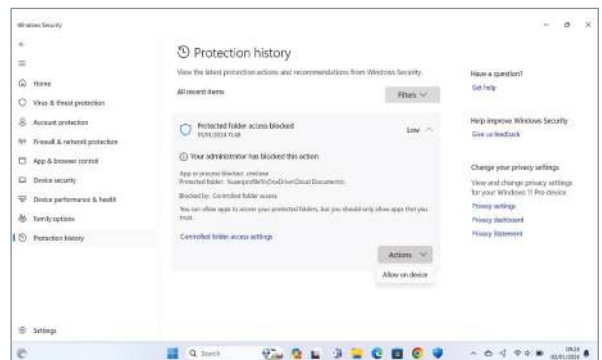
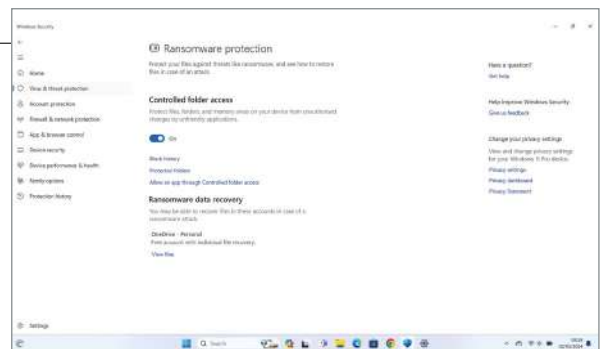
It is a little bit tiresome that you have to jump into the Windows Security app to find out what apps have been blocked. Third-party suites such as Bitdefender, Trend Micro Internet Security and the free Avast One Essential make it easier to approve access with a click directly from the alert. But if you're sticking with Windows' built-in protections it's a good idea to turn on Controlled Folder Access as soon as possible.

## 5 Anti-phishing everywhere

Another risk that's on the rise is phishing attacks, where fake websites trick you into entering the login details for your bank, email account or corporate network. In reality you're handing your credentials over to an attacker, who can then use your identity to wreak havoc without touching your computer.

Windows Security includes phishing protection as part of its SmartScreen feature: if you try to visit a web address that's been reported as unsafe, you'll see a big red warning page alerting you to the fact. However, this is only built into Microsoft's own Edge browser. If you're using Chrome, you'll get similar warnings from Google's own Safe Browsing system – but you can gain belt-and-braces protection by installing the Microsoft Defender Browser Protection extension from the Chrome Web Store, which adds SmartScreen warnings to the Google browser.

If you're using Windows 11 Pro, you can also take advantage of a feature called Enhanced Phishing Protection (introduced in the 22H2 update), which will alert you if your Windows password is entered into any untrusted website or application. You can check it's enabled by opening the Windows Security app, navigating to the App & browser control page, clicking on Reputation-based protection, and scrolling down to the Phishing protection settings. Check



**ABOVE** Controlled Folder Access can stop a ransomware attack in its tracks

that the main switch is turned on, and optionally tick "Warn me about password reuse" and "Warn me about unsafe password storage".

## 6 Built-in parental controls

There are plenty of commercial security suites that boast parental controls as part of their premium feature set, but you may be fine with Microsoft's free Family Safety service. Although this is a cloud service, you'll find a link to the web-management dashboard – plus a handy overview of what you can do – on the Family options page of the Windows Security app.

Family Safety features include time limits, app restrictions, website filtering, device tracking and a digital wallet that you can top up to allow your kids to buy online content. You can also set up and access a shared family calendar and a shared OneNote notebook for lists and memos.

The catch is that it's very Microsoft-centric. Shared resources are hosted at [outlook.com](https://outlook.com), and the money you put in kids' wallets can only be used to buy items in the Microsoft and Xbox stores. To use the full range of parental controls, your kids need to be using Windows PCs or laptops – or signing onto yours with their own

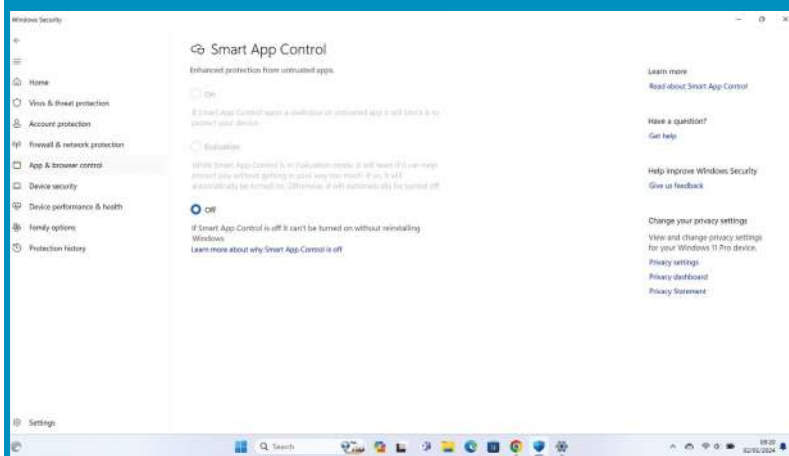
**What you may not realise is that Windows Security includes an additional feature that can completely block ransomware before it strikes**

## The more the merrier

We've seen a few reasons why you might prefer a third-party security solution over Windows' built-in antivirus features – but it doesn't have to be a black-and-white choice of one or the other. If you're running a clean installation of Windows 11 (not an upgrade from Windows 10) you may be able to activate a feature called Smart App Control, which is tucked away on the App & browser control page of the Windows Security app – or it may have been automatically turned on for you.

Smart App Control is similar to cloud-delivered protection: it uses an online service to verify that programs are safe before allowing them to run. However, it doesn't rely on the main antivirus engine, and continues to work even if you've replaced Windows' built-in protections with something else, giving you the best of both worlds.

In this configuration (which Microsoft refers to as "passive mode"), Windows 11 also continues to perform its own malware scans once a month, and will warn you if anything suspicious is detected – although it won't try to actively remove threats, to avoid conflicts with your third-party security software.



Microsoft accounts. There are some controls available for Android devices, but if your kids are using iPads, Fire tablets or Chromebooks – or gaming on other consoles – they're beyond the reach of Family Safety.

It's worth noting, too, that web filtering only works in the Microsoft Edge browser; in all, this is one area where you might want to consider running Windows Security alongside third-party tools.

## 7 Not just for your home PC

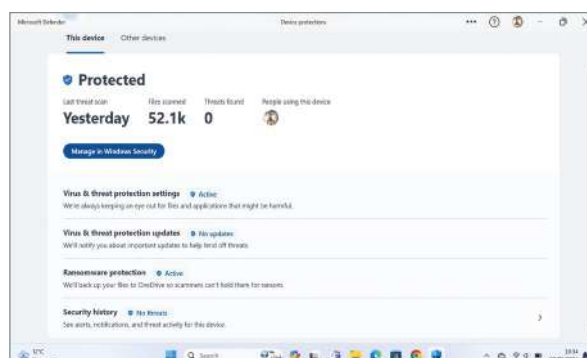
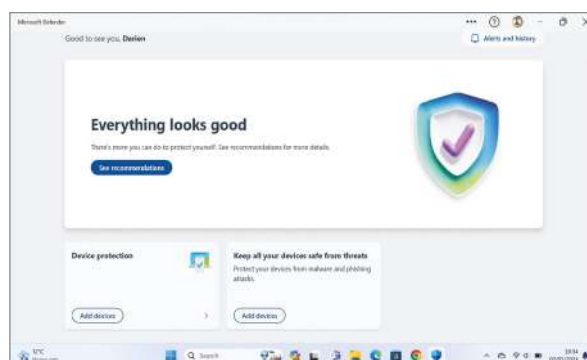
Every copy of Windows includes the core antivirus functions, but if you're subscribed to Microsoft 365, you can also take advantage of a separate tool called Microsoft Defender for Individuals (sigh), which serves as a multipurpose security dashboard for Windows, macOS, Android and iOS.

The capabilities of this tool vary from platform to platform. On Windows and iOS, the Defender app is mostly focused on monitoring the security status of all your devices, and logging incidents and notifications along with security tips. On macOS it can scan for viruses, and on Android it will not only scan all the contents of your phone and spot potentially dangerous items, but also monitor

your network traffic for suspicious activity and block connections to websites that are known to host malware, or phishing attempts.

There's also a whole spread of Defender-branded tools for big

**BELOW Microsoft 365 subscribers can take advantage of additional tools**



## Microsoft Defender for Individuals serves as a multipurpose security dashboard for Windows, macOS, Android and iOS

businesses. Defender for Endpoint is a version of the software designed for centralised deployment and management, while Defender for Office 365 scans and secures Office content. Defender for Cloud Apps watches over information that's shared over the internet, and Defender for Identity tracks suspicious account activity. Defender XDR brings all of these elements together in a cloud-based service that automatically identifies and blocks emerging attacks before they can do damage. We've come a long way from Microsoft Security Essentials.

## 8 Easier ways to manage your security

While the Windows Security app brings together a lot of valuable features, it's not exactly a joy to use. Everything's much more spaced-out than it needs to be, and its functions are split up across dozens of different pages and subpages, with little indication of which are important and which you can safely ignore.

If you'd prefer not to use the Windows Security app, you can also launch security actions using PowerShell. Two useful commands are Update-MpSignature and Start-MpScan, which respectively download the latest malware updates and start a system scan.

You can also use the extremely powerful Get-MpPreference and Set-MpPreference commands to check and change a wide range of security settings. Be warned, there are a lot of parameters here: you'll find a full list of PowerShell commands, and further documentation on how to use them, at [tinyurl.com/354powershell](https://tinyurl.com/354powershell).

Another alternative is to use a free front-end called ConfigureDefender, which you can download from [tinyurl.com/354configure](https://tinyurl.com/354configure). This third-party creation looks rather clunky, but it provides quick access to the most useful security settings via easy drop-down menus – and you can also click to instantly switch between predefined High, Interactive or Maximum security profiles, with built-in help pages to explain the differences between modes. ●





# BUILD YOUR OWN RASPBERRY PI HOME SECURITY SYSTEM FOR £52.62

Nik Rawlinson provides a step-by-step guide and explains exactly what you'll need to buy

**H**ome surveillance and alarm systems are increasingly affordable, but there's no need to buy dedicated hardware: a single-board computer like the Raspberry Pi can do the job perfectly well. With low-cost peripherals such as microphones, proximity detectors and motion sensors, you can build your own security system to rival high-end commercial offerings. Any model of Pi will work, but here's how we did it using a cheap, compact Raspberry Pi Zero 2 W.

## STEP 1 Install the operating system

You can buy a microSD card with Raspberry Pi OS pre-installed from [shop.pimoroni.com](https://shop.pimoroni.com); the 32GB version costs £9.90, the 64GB option is £19.90. But you probably own a microSD card already, and they cost from £6.19 on [amazon.co.uk](https://amazon.co.uk) at the time of writing.

Start by flashing a microSD card with the latest build of Raspberry Pi OS. You can do this using the Raspberry Pi Imager from [raspberrypi.com/software](https://raspberrypi.com/software); before imaging the card, accept the option to change your settings, as doing so at this point greatly simplifies matters when you come to boot your board.

Tick the box to specify a hostname, and give it a meaningful name – we've chosen `alarmpi.local`. Enter a username and password for logging in, and provide your network credentials so the Pi can connect to the network at boot. Click through to the second tab and enable SSH so you can administer the board remotely from your Windows machine.

Now allow the imager to download the OS and write it to your card. This can take a few minutes; when it's finished, eject the card and insert it into the slot on your Raspberry Pi.

## STEP 2 Install the camera

The last element required for a basic home security system is the camera. You can buy a Pi-compatible camera for under £30; note that Raspberry Pi produces both regular and NoIR camera hardware. The NoIR version ([tinyurl.com/354pinoir](https://tinyurl.com/354pinoir)) is sensitive to infrared light, and can be used to take pictures in the dark, while the standard version ([tinyurl.com/354camera](https://tinyurl.com/354camera)) produces better results in regular lighting. There are also wide-angle versions of each, and a high-res model, but for our purposes the standard camera unit is fine.

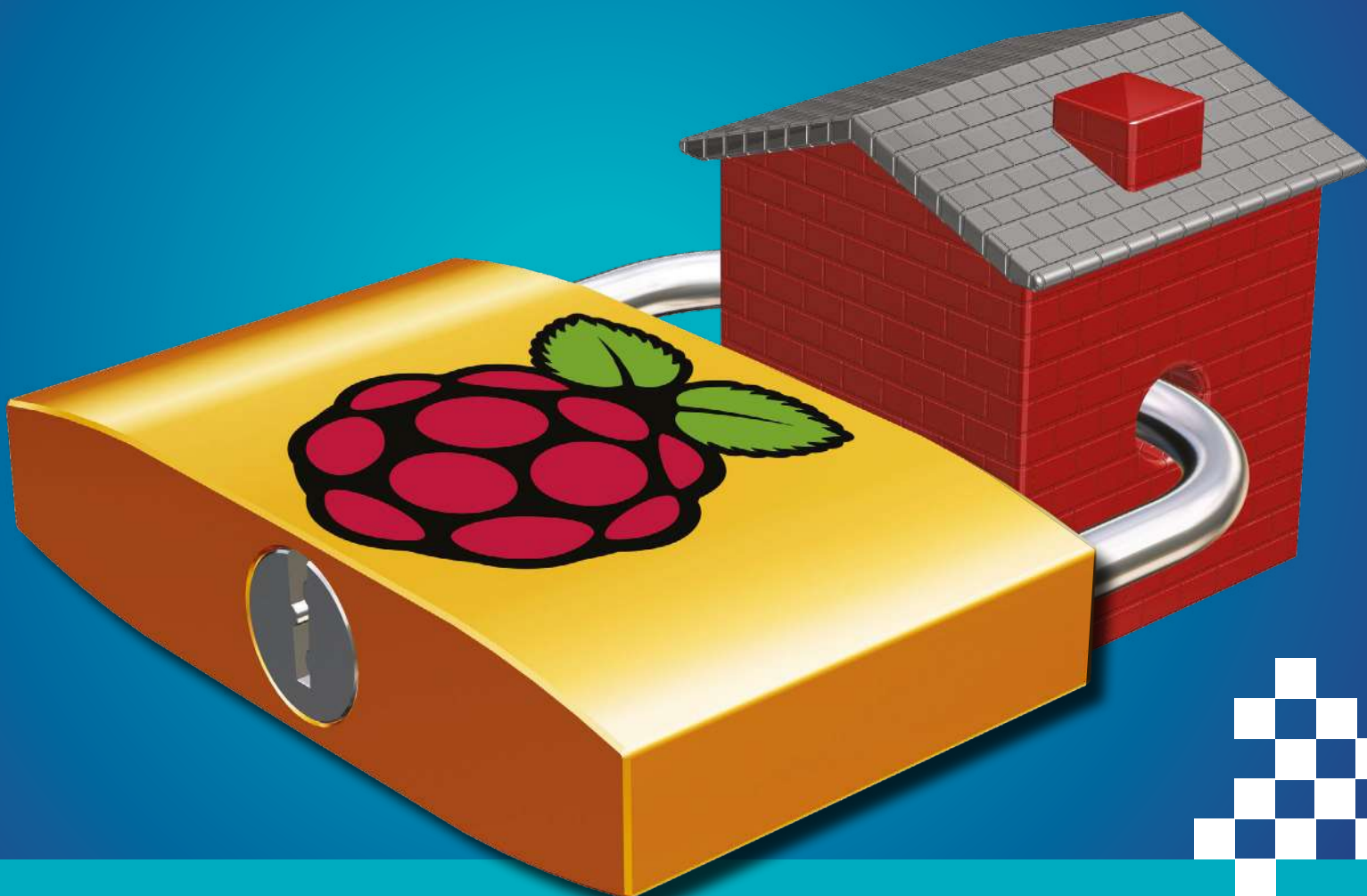
Raspberry Pi cameras all come with a standard ribbon cable that fits



**ABOVE** Ensure you have the correct ribbon cable for your Pi model

most Raspberry Pi boards, but to fit our Raspberry Pi Zero 2 W we need a different cable with a smaller connector ([tinyurl.com/354cable](https://tinyurl.com/354cable)).

Once you've got your camera and cable, you need to locate the camera connector on your Pi (on the Zero, this is at the opposite end to the SD card slot, while on full-sized Pi models it's at the mid-way point) and pull up the retaining clip. Slide the end of the cable into the gap this opens up, with the copper contacts facing away from the loose clip, then press the clip back into position to secure it.



## STEP 3 Add GPIO pins to the Raspberry Pi Zero

If you want your Pi to do anything more than basic surveillance, you'll want to add some sensor hardware. This can be attached via the 40-pin GPIO connector that's built into full-sized Pi models. However, our Raspberry Pi Zero 2 W doesn't have these pins, so we'll have to add them. If you're confident, you can do this with a soldering iron, but the easiest way is with a hammer header, which can be fitted using nothing more technical than a hammer.

If you haven't used a hammer header before then you'll need to buy a complete kit, which comes with male and female headers, plus an installation jig to help line up the pins with the holes on your board. It also includes a protective bar to prevent you from damaging the pins with your hammer. At the time of writing, the kit costs £7.20 from Pimoroni ([tinyurl.com/354hammer](https://tinyurl.com/354hammer)). You can reuse the jig, so if you need to fit pins to other devices in the future, you can buy the £2.10 solderless male header or £3 solderless female header (both are available from the same address).

For this project, you'll need male headers. To fit one, snap the acrylic base plate into three, and fit the two guide screws to the main plate. Slide

your Pi Zero over the screws so they protrude through the two holes on either side of the empty GPIO holes, with the chips on the board facing upwards. Place your male solderless header in the holes, with the shorter pins in them and the longer pins pointing up, and slide the protective bar you snapped away from the base plate over the screws to sandwich the header. Finally, put the remaining part of the base plate on the bottom of the stack (to protect the shorter pins when they're knocked through the holes).

**BELOW** You can add GPIO pins to a Raspberry Pi using a hammer header



Now put the whole thing down on a firm surface and use a small hammer to tap on the upper protective bar and push the pins through the board. Move back and forth along the bar as you go, so the pins are pushed through evenly and don't get bent or broken.

## STEP 4 Add a sound detector

One popular type of security sensor is a sound detector, which can trigger the Pi to take a photo or send an alert if an unexpected noise is detected.

These sensors are very affordable: you can buy a pack of five Youmile high-sensitivity microphones for £6.29 from Amazon ([tinyurl.com/354youmile](https://tinyurl.com/354youmile)). Note that these microphones can't record sound; they merely monitor the volume of the ambient audio, and send a signal if it passes a certain threshold.

To connect your microphone to the Pi you'll also need some socket-to-socket jumper cables. You can pick up a pack of 40 for £3 from Pimoroni ([tinyurl.com/354micjumpers](https://tinyurl.com/354micjumpers)); you'll only actually need three cables to attach the audio sensor, but you can save the rest for other sensors and future projects.





Once you have your cables you need to connect them to the appropriate GPIO pins. To identify them, hold the Pi with the pins uppermost and furthest away from you, and the detector with the microphone away from you and soldered chips on top. Now, connect the leftmost pin on the detector to the sixth pin on the bottom GPIO row on the Pi; the middle pin on the detector to the third pin on the top row of the Pi; and the rightmost pin on the detector to the first pin on the top row of the Pi.

That's all you need to do to install the microphone, but we still need to set its sensitivity, as at the default setting it's likely to trigger a response to the tiniest sounds, such as birdsong or cars driving by. We'll write a quick script to help us do this.

Start by booting your Raspberry Pi and connecting to it remotely using SSH by opening a Command Prompt on your PC and entering:

```
ssh nik@alarmpi.local
```

Replace "nik" with your own username; when asked if you want to add the fingerprint to your system, type yes and press Return, then enter the password for your Pi.

Once you're logged in, we'll create a Python script to monitor the input from the sensor, so we can tune its sensitivity to suit our needs. Enter the following line:

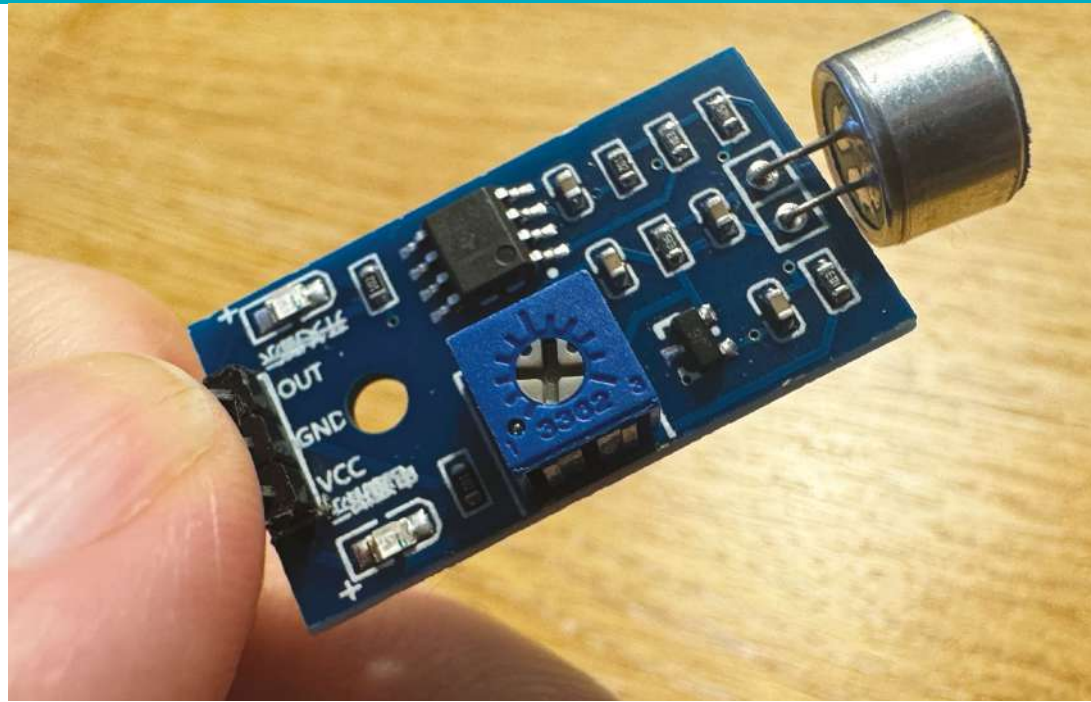
```
nano sound.py
```

And then in the editor that opens, enter the following code:

```
#!/usr/bin/python
import RPi.GPIO as GPIO
import time
GPIO.setmode(GPIO.BCM)
GPIO.setup(17, GPIO.IN, pull_up_down=GPIO.PUD_UP)
count = 1
while True:
    GPIO.wait_for_edge(17, GPIO.RISING)
    print(count)
    count = count + 1
```

The script begins by importing two libraries that respectively allow access to the GPIO pins (line 2) and Python's timekeeping functions (line 3). Then, the "while True" loop means that the last three lines – which are each indented by four spaces – will repeat forever.

Line 8 is where the magic happens. This tells the Raspberry Pi to sit and wait until the detector reports a change in the level of sound that it senses, at which point it increments a variable called "count" and prints its value to the screen. In this way



**ABOVE** Turn the potentiometer inside the raised blue square to adjust the microphone's sensitivity

we can see every time a change in sound level is detected.

Press Ctrl+x to quit the nano editor, and press y when asked if you want to save your file. Now run the script by entering:

```
python sound.py
```

You should immediately see a string of numbers appear on your screen, indicating that the microphone is continually detecting audio events.

Now take a very small screwdriver and turn the potentiometer on the sound detector until the numbers stop: once this happens, you've decreased the microphone's sensitivity to the point where it's not registering

any background noise. Now try knocking on your desk or clicking your fingers in front of the mic; the LED on the microphone should briefly flicker on and off, and the numbers on your screen should update, then stop. If not, dial the potentiometer back slightly and try again.

Once you've found a good level, close the Command Prompt (this is the easiest way to stop the script, as the Ctrl+c shortcut doesn't work over SSH). Reopen your sound.py file in nano, and replace its contents with the following lines:

```
#!/usr/bin/python
import RPi.GPIO as GPIO
import time
from datetime import datetime
GPIO.setmode(GPIO.BCM)
GPIO.setup(17, GPIO.IN, pull_up_down=GPIO.PUD_UP)
while True:
    GPIO.wait_for_edge(17, GPIO.RISING)
    now = datetime.now()
    datestring = now.strftime("%H:%M:%S %d %B %Y\n")
    print(datestring)
    output = open("/home/nik/alert.txt", "a")
    output.write(datestring)
    output.close()
    flag = open("/home/nik/flag", "a")
    flag.close()
    time.sleep(5)
```

As before, replace "nik" with your own username.

This script significantly increases the features of our program. Once again, it starts by importing the libraries it needs to use, then begins listening for changes registered by the sound detector. When something happens, it logs the current date and time to a file called alert.txt – which will serve as a record of all detections stretching back to the time the program was first run. It also creates a file called flag, without an extension, in the same folder, whose presence indicates that an audio event has been detected.

The script then closes both of these files and rests for five seconds, so it isn't immediately triggered by the same sound again. If you want to increase the length of the pause, edit the command on the last line.

Save the file and quit nano. Now all you need is some way to alert yourself (or other scripts) that an audio alarm

has been triggered, and to save the evidence somewhere secure.

## STEP 5 Upload your alert to a web server

For this step you'll need an account on a web server with FTP access. If you don't already have a web host, it's possible to run a server directly on the Raspberry Pi – see [tinyurl.com/354webhost](http://tinyurl.com/354webhost) for guidance. However, it's better to use a remote server, as this way your captured security data will be safe even if a thief steals your local hardware. For this project, we'll assume you're using a third-party hosting account.

To handle the uploading, we'll use a simple shell script. To do this, enter the following command in the ssh window:

```
nano upload.sh
```

Now enter the following code in the new file this creates, save the file and quit the editor.

```
#!/bin/bash
if test -f /home/nik/flag; then
    curl -T /home/nik/alert.txt ftp://
server/lounge-alarm.txt --user
username:password
    curl -T /home/nik/flag ftp://server/
lounge-flag --user username:password
    rm /home/nik/flag
fi
```

Replace each occurrence of “nik” with your own Raspberry Pi username, and note that the lines between “if” and “fi” are indented by four spaces each. Replace “username” and “password” with the FTP credentials for your web server.

This script checks to see whether the file “flag” exists in your home directory; if it does, it connects to the FTP server and uploads both the log of detected sounds and the flag file itself. In the process, it renames the log file “lounge-alarm.txt” and the flag file “lounge-flag”; this means we can expand the system in the future with additional sensors, and know which room each one relates to. Finally, the script deletes the “flag” file, so the upload won't be triggered again until a new sound is detected.

The final step is to set your two Python scripts to run automatically. The one that detects sound should be active all the time, while the upload script only needs to run periodically – we'll set ours to check for the flag file every five minutes.

To configure it, we'll use the cron utility, which lets you schedule jobs to run automatically at particular times or intervals. To do this, enter:

```
sudo crontab -e
```

Then press 1 to edit the crontab file using nano. Navigate down to the bottom of the file and add the following lines:

```
@reboot python /home/nik/sound.py &
*/5 * * * * /home/nik/upload.sh
```

Once again, replace “nik” with your own username. Quit nano and save your file, then reboot your Raspberry Pi by entering:

```
sudo reboot
```

As you might assume, the @reboot line runs the specified script when the computer first starts. The ampersand (&) at the end of the line tells the Pi to run the script in the background, and not to wait for it to complete before continuing with other tasks.

The second line tells it to run our upload script every five minutes. The syntax isn't very intuitive, but suffice it to say that if we wanted it to run this job every ten minutes, we'd change the \*/5 to \*/10. You can find a fuller explanation, with more examples of crontab syntax, at [crontab.guru/examples.html](http://crontab.guru/examples.html).

Now that we've uploaded our flag file to the server, we can use whatever device we like to check it remotely. We could even set up another Raspberry Pi with a display showing the current status of this sensor, and any others we might install.

## STEP 6 Install a proximity sensor

Audio alerts are all very well, but a crafty cat burglar might be quiet enough to evade the sound detector. So as well as detecting sound, you can deploy a proximity sensor. You can pick up a Waveshare laser receiver

module for around £14 ([tinyurl.com/354waveshare](http://tinyurl.com/354waveshare)) – but note that this sensor is designed to work with a microcontroller board such as the Raspberry Pi Pico, so we'll be adding an additional board to our home security system. That won't break the bank: the Pico WH comes with onboard wireless networking and pre-soldered headers for £7.20.

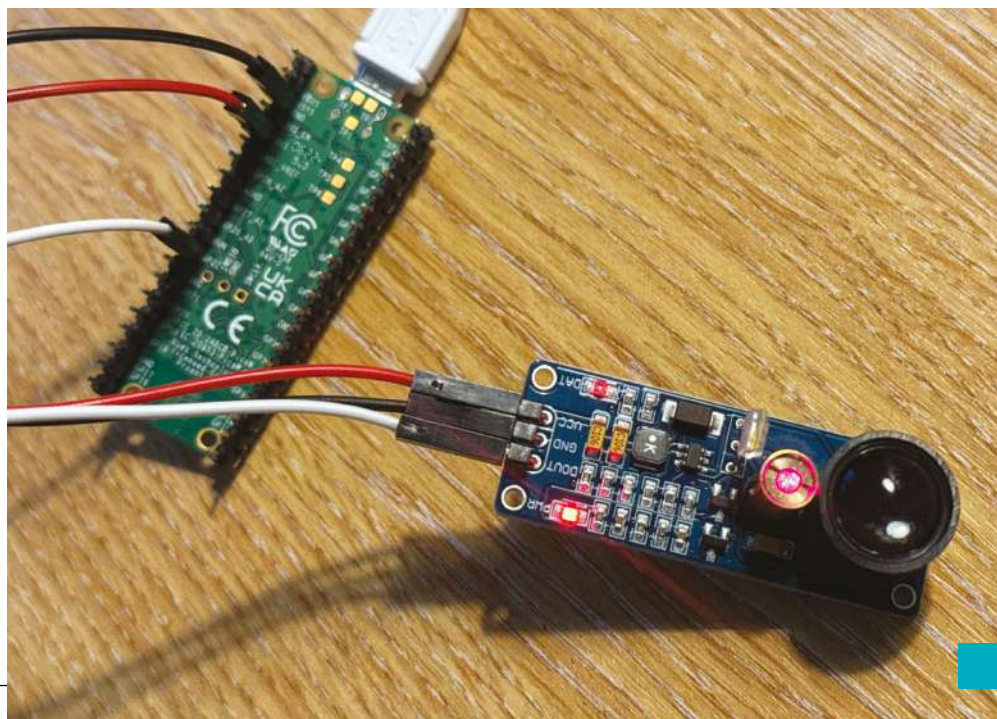
Make sure the Pico isn't powered on when you attach the receiver, as the laser will illuminate as soon as you connect the power jumper and you don't want to accidentally shine the laser into your eyes. If you're using a Pi with labelled GPIO pins, you need to connect the VCC line on the sensor to 3V3\_EN on the Pi, GND on the sensor to GND, and DOUT on the sensor to GP22.

If you've fitted your own hammer header, connect the leftmost pin on the sensor to the third pin from the top on the left side of the Pi; the middle pin on the sensor to the fifth pin from the top on the left side of the Pi; and the rightmost pin on the sensor to the 12th pin from the top on the left side of the Pi. Once this is done, position the laser in such a way that it will point directly at the door you're monitoring when it's closed.

As with the sound sensor, we can process the input from the proximity sensor using a few simple scripts. In this case, we'll start by creating two PHP scripts that run on the web server. The first one should be called open.php, and contain the following lines:

**BELOW** As soon as you connect the laser sensor to power it will become active

```
<?php
$doorfile = fopen("door.txt", "a") or
die("Unable to open file!");
$string = "Opened: " . date('g:i:sa') . " on
" . date('l jS F, Y') . ".\n";
```







```
fwrite($doorfile,$string);
fclose($doorfile);
?>
```

Save this file, then create another script on your web server called `close.php`. This should contain the same code, except the word “Opened” on line three should be changed to “Closed”. When one of these scripts executes it will open a file called “door.txt”, and append either the word “Opened” or the word “Closed”, followed by the current time and date, and a Return character.

Now we can write the local script that runs on the Pi. Since we’re using a Pico board rather than a full-fat Raspberry Pi, we’ll need to use Micropython rather than regular Python; for this we recommend the Thonny IDE, which is a free download from [thonny.org](https://thonny.org). Install this on your PC, then connect your Pico to the PC (taking care to avoid the laser, which will fire up automatically), then start Thonny. Click Thonny’s Python in the bottom right corner and click “MicroPython (Raspberry Pi Pico)” on the menu that pops up.

Now press the STOP button on the main toolbar to make sure the Pico isn’t occupied, then create a new file in Thonny and enter these lines into the upper window (replacing “network name” and “network password” with the appropriate text for your home network):

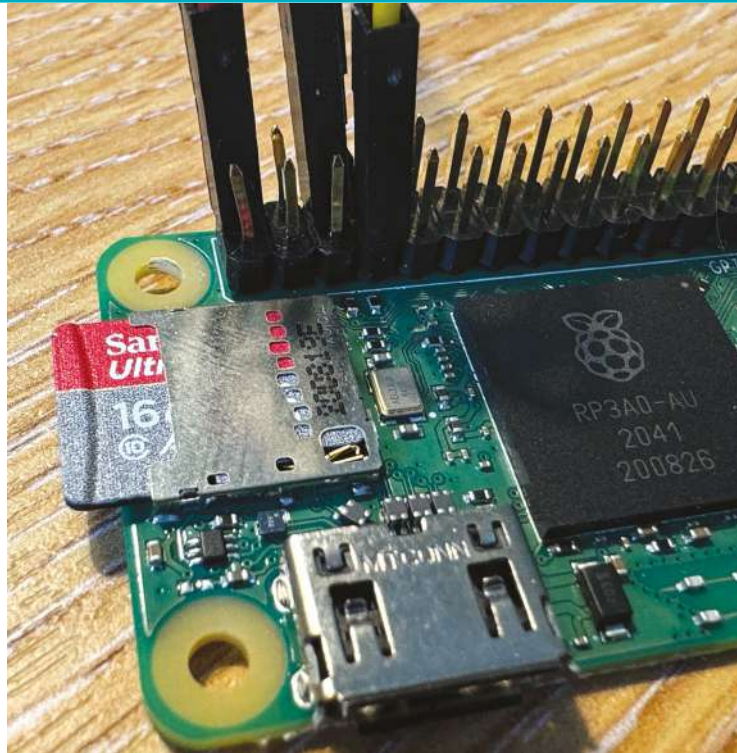
```
SSID = "network name"
PASSWORD = "network password"
```

```
from machine import Pin,ADC
import utime
import urequests
import network
import credentials

laser = Pin(22,Pin.IN)
status = "closed"

wlan = network.WLAN(network.STA_IF)
wlan.active(True)
wlan.connect(credentials.SSID,credentials.PASSWORD)
while wlan.isconnected() == False:
    time.sleep(1)
ip = wlan.ifconfig()[0]

while True:
    if(laser.value() == 1):
    if(status == "closed"):
        urequests.get('https://server_address/open.php')
        status = "open"
        utime.sleep(1)
    else:
    if(status == "open"):
        urequests.get('https://server_address/close.php')
        status = "closed"
        utime.sleep(1)
```



Click the Save button, click Raspberry Pi Pico, and save the file as “credentials.py”. Next, create a new file in Thonny and enter the code from the blue box below – replacing “server\_address” with the domain and folder where you saved the two PHP files.

As with the Python code we wrote for the sound detector, this script starts by importing the libraries on which the code relies, plus the network details from `credentials.py`

**ABOVE A PIR sensor lets you use motion detection to activate the camera**

(there’s no need to include the `.py` at the end of the line).

We then create a variable called “laser” to store data received from pin 22 on the Pico. This will contain “0” when the laser is being reflected back to the lens, and “1” when it’s not. We also create a flag called “status”, which is set to “closed”, indicating that the door we’re watching is closed.

The “wlan” section connects to the Wi-Fi network – unlike the Raspberry Pi Zero, the Pico requires you to do this manually – before the code enters a never-ending loop.

This first checks whether the variable “laser” contains the

value “1”. If it does, we know that the door is open; we then check our “status” flag. If it contains the word “closed”, that means the status of the door has changed, so we load the file `open.php` on the server. This adds a new line to the `door.txt` file on the server noting that the door has opened, and when it did so. The script then changes the “status” flag to “open”, and pauses for a second before restarting the loop.

If the variable “laser” doesn’t contain the value “1”, the second part of the loop runs instead. This checks whether the door was previously registered as open; if it was, it calls `close.php` on the server, which logs a new line to the text file recording the time and date of the change. It then sets the flag to “closed”, pauses briefly and returns to the start of the loop.

This simple script will keep a complete online record of every time the door opens and closes. If you only want to know when the state of the door changes, you could alternatively use a simple flag, as we did with the audio sensor above.

## STEP 7 Detect motion

When your door opens, or your sound detector registers a noise, you’ll probably want to know what’s happened. A simple way to do this is to take a picture. You could add code to the above scripts to capture an image whenever an event is triggered – or you could use an independent sensor to take a photo whenever movement is detected in the vicinity.

A PIR (passive infrared) sensor can be picked up for just £3 ([tinypurl.com/354PIR](https://tinypurl.com/354PIR)), and will connect to

your Pi Zero using another three jump cables. To connect it, disconnect your Pi from its power supply, then place the board on a firm surface with the double row of pins running left to right, at the far edge of the board. Turn the sensor over so the pins are pointing up, at the edge nearest to you. Now connect the leftmost pin on the sensor to the leftmost top-row pin on the Pi; the middle pin on the sensor to the fourth bottom-row pin on the Pi; and the rightmost pin to the third top-row pin on the Pi.

We'll use the Picamera2 library to control the camera from Python. This is installed by default in recent OS releases, so if you're using an older Pi the easiest way to get it is to write the latest OS build to your microSD card, and boot from that.

If you're using a Raspberry Pi 3 or earlier, you'll also need to manually enable graphic acceleration. To do this, connect to the device via SSH (or open a Terminal window on the Pi itself), and enter:

```
sudo raspi-config
```

Key down to Advanced Options and press Return; then navigate down to Glamor and press Return again. Enable acceleration, then exit raspi-config and reboot the Pi. With this done we'll once again write

a Python script to handle the camera. Reconnect to the Pi and then enter the following:

```
nano camera.py
```

Then enter the code from the blue box below, replacing "ftp\_server", "ftp\_username" and "ftp\_password" with your server address and login details. Note that the line beginning "upload.cwd" assumes that your web files are stored in a folder called "public\_html" – if this isn't right then edit this line too as appropriate.

As you'll recognise from previous scripts, this code starts by loading the required libraries, including Picamera2 for accessing the camera, gpiozero for reading the GPIO pins, ftplib for uploading files to a remote server, os for managing local files and various time and date functions.

The next few lines create holders for the camera and sensor, and set the camera resolution to 1,920 x 1,080 pixels. The code then wakes up the camera, waits a few seconds for it to initialise, and enters the main loop.

This loop spends most of its time waiting for the camera to detect any sort of movement. When that happens, it captures the current date and time, assembles them into a timestamped filename, takes a photo and saves it to disk under that name.

```
from picamera2 import Picamera2, Preview
from gpiozero import MotionSensor
import ftplib
import time
import datetime
import os, stat
camera = Picamera2()
pir = MotionSensor(4)
camera_config = camera.create_still_configuration(main={"size": (1920, 1080)})
camera.configure(camera_config)
camera.start()
time.sleep(2)
while True:
    pir.wait_for_motion()
    now = datetime.datetime.now()
    filename = now.strftime("%Y-%m-%d-%H-%M-%S") + ".jpg"
    filenamefull = "/home/nik/" + filename
    camera.capture_file(filenamefull)
    os.chmod(filenamefull, stat.S_IRWXO)
    print("Picture taken")
    upload = ftplib.FTP("ftp_server", "ftp_username", "ftp_password")
    upload.encoding = "utf-8"
    upload.cwd("public_html")
    files = upload.dir()
    print(files)
    print("Connected to server")
    file = open(filenamefull, 'rb')
    upload.storbinary("STOR%s"%filename, file)
    file.close()
    upload.quit()
    print("Picture uploaded")
    os.remove(filenamefull)
    time.sleep(20)
```

## Core shopping list

Raspberry Pi Zero 2 W	£17.10
Camera module	£26.40
Camera cable	£1.92
Hammer header	£7.20
<b>TOTAL</b>	<b>£52.62</b>

## Options

64GB microSD card	£6.19
Youmile mics (five-pack)	£6.29
Mic jumpers (40-pack)	£3
Proximity sensor	£13.99
PIR motion sensor	£3

Finally, the code connects to our FTP server and uploads the file. It deletes the local copy (so our SD card doesn't get full over time), then pauses for 20 seconds so the process isn't instantly triggered again. You can shorten this interval by reducing the

number on the last line.

As with the sound-detection script, the last step is to set this script to run in the background when the Raspberry Pi boots. Again, we'll set this up using cron. At the Raspberry Pi terminal prompt, enter:

```
sudo crontab -e
```

Select nano as your crontab editor if prompted (if you've edited crontab before you won't be asked again) then scroll down to the bottom of the file and enter the following on a new line, replacing "nik" with your username:

```
@reboot python3 /home/nik/camera.py
```

Press Ctrl+x to quit nano, and Return when asked if you want to write the file to disk. Now power down your Pi, move the board and camera to wherever you want them, and reboot. Your home security system should now be up and running.

## STEP 8 Use your evidence

With a few low-cost sensors and a handful of scripts, you can now log when sounds are detected, track doors opening and closing, and take photos of activity in the vicinity. All of this information is automatically uploaded to a remote server, safely out of reach of intruders.

What you do with this information is up to you. You might just wish to store it in case of future need – or you could write one more script in Python to continually check for changes to your server-hosted logs and send you a warning if anything suspicious is going on, perhaps as an email, or an SMS sent via an online gateway.

Alternatively, you could attach a display to your Raspberry Pi, to show an at-a-glance readout of your home security. This might not be as sophisticated as a commercial security system, but it should give you some peace of mind – and the satisfaction of having assembled the project yourself. ●



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## Intel Core Ultra

Don't expect a revolution, but this is a solid step forward for Intel in every key area – including AI and graphics



Intel has finally released its much-trailed Core Ultra chips – codenamed Meteor Lake – in its bid to power “AI PCs”. That is, laptops and desktops with silicon that incorporates not merely a CPU and GPU, but a neural processing unit (NPU) as well.

While question marks still hang over the usefulness of AI PCs (read *Barry Collins’ take on p29*), there’s a good chance a laptop you buy in 2024 will include one. The Core Ultra is now Intel’s mainstream notebook chip, ranging from the Ultra 5 125U to the Ultra 9 185H.

### ■ New era, new node

The processors are the first consumer chips built on the company’s Intel 4 process node, using its Foveros 3D hybrid architecture. This allows Intel to stack chiplets (it calls them “tiles”) atop one another, and it adds up to Intel’s biggest architectural shift for over a decade.

Meteor Lake has four active tiles: a compute (CPU) tile, a graphics (GPU) tile, an SoC tile and an I/O tile. The external foundry TSMC will manufacture the I/O, SoC and GPU tiles to Intel’s design, while Intel manufactures the CPU tiles on its Intel 4 process. All four of these active tiles

ride on top of a single Intel-produced Foveros 3D base tile that ties together the functional units with sufficient bandwidth and low enough latency for the chip to function as close to one monolithic die as possible.

Meteor Lake has three compute units that can process AI workloads, namely the CPU, NPU and GPU. AI workloads will be directed to each unit based as required.

As before, Intel has a mixture of P-cores and E-cores, with P-cores handling latency-sensitive single-threaded and multithreaded work, while the E-cores step in to handle both background and heavily threaded tasks. However, these two

**ABOVE** Intel’s Meteor Lake chips include a neural processing unit

**BELOW** Each Core Ultra chip is formed of four active “tiles”



types of cores are now augmented by two new low-power-island E-cores located on the SoC tile. These cores are geared for the lowest-power tasks. Intel calls this new three-tier core hierarchy the 3D performance hybrid architecture.

### ■ You can’t have a P

We print the entire (current) lineup of Intel Core Ultra chips on the opposite page, which immediately raises some questions. What, for example, has happened to the P-series of chips from previous Core families? The answer: they’ve gone, having been merged with the H-series to cover middle-tier and high-end laptops. The U-series remains for low-power laptops and ultraportables. As the table details, they either consume 9W or 15W as base power, compared to the 28W of the H-series (aside from the 45W Ultra 9 185H).

The entire collection has the same NPU, but the graphics offering varies considerably. At the top of the pile sits the Core Ultra’s Arc-branded GPUs, which offer a big step up over Intel’s previous-generation Iris Xe integrated GPUs, but they’re limited to H-series processors.

Additionally, Intel claims that the new processors will be extremely

efficient, adding substantial battery life thanks to both the node shrink and the use of the NPU. For example, Intel says the 28W Ultra 7 165H uses 25% less power than the Core i7-1370P while streaming Netflix video. The reason? The latter chip uses P-cores and E-cores for that task, while the new Core Ultra only uses the low-power efficiency cores.

Intel also makes big claims about its power efficiency versus AMD-based laptops – “up to 79% lower power [at idle in Windows] than AMD at the same 28W envelope for ultrathin notebooks” – but we will hold judgement on that.

It also claims “leadership CPU compute for Ultrathin PCs”, specifically sharing results for a Core Ultra 7 165H that suggested it was “up to 11% faster” in multithreaded tasks than an AMD Ryzen 7840U at similar power settings. Intel also claimed big victories, ranging from +19% to +41%, using the Ultra 7 155H over the 7840U and 1360P in UL Procyon, PugetBench for Premiere Pro and PugetBench for Adobe Lightroom. The small print mentioned that an Apple M3 was also tested, but the results curiously aren’t listed on all of Intel’s slides.

## Graphic improvements

For graphics, Intel is touting its new Arc GPU with the overarching promise of double the performance per watt – a claim that our early tests confirm, give or take. The Arc branding will only be used by H-series Intel Core Ultra processors with at least 16GB of dual-channel RAM. Otherwise, you get Intel Graphics.

If you think that’s confusing, just wait. The new graphics architecture is called Xe-LPG, the low-power gaming alternative to Xe-HPG – which is the GPU found in the desktop Intel Arc Alchemist GPUs. Xe-LPG is not to be confused with Xe LP, which was the graphics solution used in Intel’s 11th, 12th and 13th gen Core processors.



The U-series chips – with mere Intel Graphics – include four Xe-LPG cores with lower peak frequencies than their H-series counterparts. Logic suggests they will be half as fast as the H-series chips that feature eight Xe-LPG cores, but we don’t yet have testing to back this up.

Intel is touting DX12 Ultimate support, Xe SuperSampling and an engine (supporting DP4a) to help with AI acceleration. There’s also support for DisplayPort 2.1 UHBR20 (20Gbits/sec per lane, 80Gbits/sec total).

## The AI question

Finally we come to the NPU tile. The Core Ultra 7 165H can deliver up to 34 tera operations per second (TOPS) on the CPU, GPU and NPU combined, but Intel hasn’t broken down the TOPS across each one individually. For comparison, the AMD Ryzen 8040 series can reach 39 TOPS, up from 33 TOPS for the 7040 family.

To compare AI performance, Intel matched its Ultra 7 165H against a Core i7-1370P and Ryzen 7 7840U with Ryzen AI, with Intel’s new chip coming top across a series of (Intel-chosen) benchmarks. For example, it claims that it was 1.7x faster than the Ryzen chip in Adobe Premiere Pro’s AI workflows (colour grade, scene edit, export) and 3.2x faster for Stable Diffusion A1111.

**ABOVE** The Core Ultra comes in H-series and U-series variations

But AMD could probably pick its own benchmarks with similar figures..

What’s more interesting is the apps Intel has chosen – Wondershare Filmora, Adobe Lightroom, DaVinci Resolve – as this tells us where it feels AI makes a difference. This also means less power consumption in Zoom, with Intel claiming a 38% reduction thanks to NPU offloading.

But the real question is how useful the AI features will be, and to whom. Intel says it has partnered with more than 100 software vendors to come up with over 300 “features”,

and that its support for OpenVINO should allow for great development support. We shall see.

**“Intel claims that the new processors will be extremely efficient, adding substantial battery life”**

## Coming to a laptop near you

This month we review our first Intel Core Ultra laptop in the Acer Swift Go 14 (see p50), but that’s just the start. It seems straightforward for Intel’s partners to update their existing designs to accommodate the new package, with several examples in our CES feature (see p26) and hundreds more on their way.

While it’s too early to say whether the Core Ultra is a sure-fire success in terms of performance, we can safely say that it has the backing of all the big manufacturers. **TIM DANTON**

Complete lineup of Intel Core Ultra processors

	Intel Core Ultra 9 185H*	Intel Core Ultra 7 165H	Intel Core Ultra 7 155H	Intel Core Ultra 5 135H	Intel Core Ultra 5 125H	Intel Core Ultra 7 165U	Intel Core Ultra 7 164U*	Intel Core Ultra 7 155U	Intel Core Ultra 5 135U	Intel Core Ultra 5 134U*	Intel Core Ultra 5 125U
Cores/threads	16/22	16/22	16/22	14/18	14/18	12/14	12/14	12/14	12/14	12/14	12/14
P-cores	6	6	6	4	4	2	2	2	2	2	2
E-cores	8 (2 LP)	8 (2 LP)	8 (2 LP)	8 (2 LP)	7 (2 LP)	8 (2 LP)	8 (2 LP)	8 (2 LP)	8 (2 LP)	8 (2 LP)	8 (2 LP)
Smart Cache (LLC)	24MB	24MB	24MB	18MB	18MB	12MB	12MB	12MB	12MB	12MB	12MB
Max turbo frequency (P-cores/E-cores)	5.1GHz/3.8GHz	5GHz/3.8GHz	4.8GHz/3.8GHz	4.6GHz/3.6GHz	4.5GHz/3.6GHz	4.9GHz/3.8GHz	4.8GHz/3.8GHz	4.8GHz/3.8GHz	4.4GHz/3.6GHz	4.4GHz/3.6GHz	4.3GHz/3.5GHz
Integrated GPU	Intel Arc GPU, 2.35GHz max, 8 Xe cores	Intel Arc GPU, 2.3GHz max, 8 Xe cores	Intel Arc GPU, 2.25GHz max, 8 Xe cores	Intel Arc GPU, 2.2GHz max, 7 Xe cores	Intel Arc GPU, 2.2GHz max, 7 Xe cores	Intel Graphics, 2GHz max, 4 Xe cores	Intel Graphics, 1.8GHz max, 4 Xe cores	Intel Graphics, 1.95GHz max, 4 Xe cores	Intel Graphics, 1.9GHz max, 4 Xe cores	Intel Graphics, 1.75GHz max, 4 Xe cores	Intel Graphics, 1.85GHz max, 4 Xe cores
Neural processor	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3	Intel AI Boost, 2x Gen 3
Max memory speed	DDR5-5600, LPDDR/x-7467	DDR5-5600, LPDDR/x-7467	DDR5-5600, LPDDR/x-7467	DDR5-5600, LPDDR/x-7467	DDR5-5600, LPDDR/x-7467	DDR5-5600, LPDDR/x-7467	LPDDR5/x-6400	DDR5-5600, LPDDR/x-7467	DDR5-5600, LPDDR/x-7467	LPDDR5/x-6400	DDR5-5600, LPDDR/x-7467
Max memory capacity	64GB (LP5)/96GB (DDR5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)/96GB (DDR5)	64GB (LP5)	64GB (LP5)/96GB (DDR5)
Base power (W)	45W	28W	28W	28W	28W	15W	9W	15W	15W	9W	15W
Turbo power (W)	115W	64W, 115W	64W, 115W	64W, 115W	64W, 115W	57W	30W	57W	57W	30W	57W

\*Expected Q1 2024





## Acer Swift Go 14 OLED (SFG14-72)

A great debut for Intel's Core Ultra 7, which turns the Swift Go 14 into a highly attractive mid-range laptop

**SCORE** ★★★★★

**PRICE** As reviewed, £916 (£1,099 inc VAT) from [currys.co.uk](https://www.currys.co.uk)

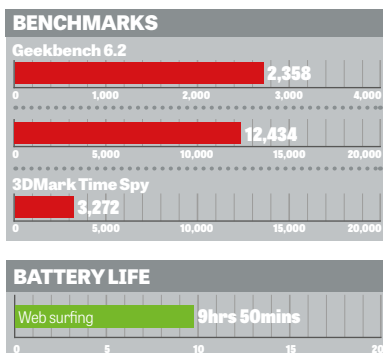
**A**cer's Swift Go 14 lived up to its name, being the first laptop to arrive in our labs with Intel's Core Ultra inside (see p46). In the case of our review system, that means a Core Ultra 7 155H, giving us our first glimpse at both Intel's eight-core integrated Arc graphics and the all-new neural processing unit (NPU). This trinity of CPU, GPU and NPU combines to great effect in this update to the Acer Swift Go 14, even comparing favourably with the 13in MacBook Air M2 (see issue 336, p50).

It does so without throwing away what makes Acer Swift laptops so attractive: their blend of portability and performance for a competitive price. The Acer Swift Go 14 I test here costs £1,099, with 16GB of RAM and 1TB of SSD storage, while £899 halves the SSD capacity and drops you down to a Core Ultra 5. Importantly, both versions come with a 14in OLED display packing 2,560 x 1,440 pixels. As always with Acer, you're getting a lot of laptop for your money.

My only note of caution is that Currys is still selling the previous generation of this laptop with older Intel and AMD processors (and lesser screens). Nor is it to be confused with the Acer Swift X 14 that made its debut at CES (see p26). Make sure you pick the right one.

### ■ Chance to shine

As this is the first Core Ultra system we've tested, I decided to push it. First, multitasking. I cranked up



Google Chrome, set five YouTube videos playing, opened 65 tabs and then started working in Google Docs. It didn't even flinch. So I opened another tab to Photopea and began editing photos; even then, the Acer Swift Go 14 acted like it wanted more, handling it all without a stutter.

Time to ramp things up with benchmarks. The Geekbench 6.2 test, which focuses on CPU performance, proved little obstacle. The Go 14 scored 12,434 in the multicore test, beating the MacBook Air M2's score of 9,467. It also outperformed the Acer Swift Edge 16 (see issue 351, p42) with an NPU-equipped Ryzen 7 7840U inside, which returned 10,563.

But let's not get too excited: when I tested the previous generation Swift Go 14, which included a Core i7-13700H processor, it returned 11,950. Then again, that was one of the most powerful chips available for such a thin laptop.

In our Handbrake video-transcoding benchmark, which tests how fast a laptop can convert a 4K video to 1080p resolution, the new Swift Go 14 took 5mins 18secs, easily outpacing the Ryzen-powered Swift Edge 16's time of 6mins 10secs. Again, it wasn't a huge jump over the 5mins 35secs of the Core i7 version, but made the M2 Air look slow with a time of 7mins 52secs.

For outright processing tasks, then, this is a strong first showing for Intel's

**ABOVE** Powerful and fast, the Swift Go 14 showcases Intel's Core Ultra to fine effect

**"I cranked up Chrome, set five YouTube videos playing, opened 65 tabs and started working in Google Docs. It didn't even flinch"**

**BELOW** The Acer's excellent keyboard has well-spaced keys and is a joy to type on

Core Ultra chips. And while it's impossible to say how much difference the new low-power E-cores make, or the NPU, my first impression is that combined they do indeed lift overall performance by freeing up the P-cores to focus on more demanding tasks.

### ■ Arc de triumph

I can be even more definitive about the Arc GPU: this is a big jump from the Iris Xe graphics that came before.

And it isn't solely about gaming. Arc graphics open up a whole new world of performance and capabilities, such as smoothly editing 4K footage in a GPU-demanding application such as DaVinci Resolve, and this is before Blackmagic has added any Intel Ultra Core-specific acceleration.

For gaming, I first tested the GPU with *Sid Meier's Civilization VI* benchmark at 1080p. The new Go 14 scored 54fps, double the speed of the old Swift Go 14 and a solid improvement over both the Swift Edge 16 (35fps) and the MacBook Air

M2 (40fps).

I also played *Borderlands 2* and *Ghost Runner 2* on the unit, with the former running perfectly. *Ghost Runner* struggled at first but, after some tweaks behind the scenes (nothing to do with me; this was the system learning as it went along, it seems) the Swift Go adjusted



and ran between 24 and 40 frames per second most times. Not perfect, but just about acceptable.

Running the 3DMark Time Spy benchmark, the Swift Go 14 tallied a score of 3,272, beating the previous generation's 2,025 (itself a strong score for an Iris Xe machine). In short, we're seeing dramatic overall improvements between the two. Here, though, the Ryzen 7840U's integrated Radeon 780M graphics closed the gap, returning 2,675.

## Battery plus

Despite all this power, the Acer Swift Go 14's two-fan cooling system proved both potent and quiet. During our light-use heat test, which involves playing a 15-minute 1080p video and then immediately measuring the temperature at various points on the laptop, the Go 14's underside reached an acceptable 34.4°C, just below our 35°C comfort threshold.

Battery life is another area where we can see the benefits of the Intel Core Ultra chipset. Gen on gen versus its predecessor, the Swift Go 14 gains more than two hours of battery life, reaching 9hrs 50mins in our web-surfing battery test over Wi-Fi at 150cd/m² brightness. The MacBook Air wins outright, though, lasting for 14hrs 6mins in the same test.

The Air also wins for svelteness, measuring 11.3mm thick to the 15mm of the Swift, but it weighs a similar amount (1.2kg versus 1.3kg), and the Acer's all-aluminium chassis feels like it will survive on the road. It looks premium, too, with a sparkly metallic silver lid. While others may prefer the Air's industrial chic, I prefer the Swift Go for its added personality – even the chromed-out logo on the rear of the lid adds zing.

It also comes with a far better collection of ports and connectivity options than the Air. On the left, you'll find a microSD port, combo audio jack, USB-A port and a nano Kensington lock. The right side holds a second USB-A port, HDMI output and two Thunderbolt 4 ports, which handle both display output and charging.

But it's the display that truly dazzles. There's nothing wrong with the 13.6in IPS panel on the MacBook, but Acer ups the ante in every department: OLED technology for richer blacks, 90Hz refresh rates and it's a fraction bigger at 14in. Apple's display has a marginally higher resolution, but I defy anyone to notice that in practice.

Colour coverage and accuracy is excellent too. It covers 99% of the DCI-P3 gamut, significantly more

than the 13in M2 MacBook Air with 76%, and with an average Delta E of 0.36. It's bright, too, peaking at 520cd/m² compared to the Air's 489cd/m².

## Modern worker

I also found myself wanting to turn up the intensity of the speakers. Quality is strong – for example, I fired up one of my favourite house music tracks and the bassline hit hard without distortion – but I wished they were louder. Vocals and effects again came through crisply, while the built-in mics did an excellent job focusing on my voice, while keeping background noise to a minimum during a Zoom call.

This brings me to the Swift Go 14's excellent QHD (2,560 x 1,440) webcam, which performed well in both normal lighting and low-light conditions. Autofocus and tracking are speedy, too, as was Windows Hello, making this one of the better built-in webcam experiences.

Web calls are also where the AI smarts of Intel's Core Ultra chips kick in. Windows Studio Effects provides clever features such as speedy automatic framing, background blur and gaze correction. Acer also bundles a bunch of AI-enhanced tools to increase image quality, such as "temporal noise reduction" (TNR).

There's more good news for anyone seeking a laptop to work on: the Swift Go 14's keyboard is excellent. Its chiclet-style keys are snappy, with excellent bounce, and bright backlighting combined with plenty of spaces between keys makes it a pleasure to use in all conditions. I managed a sprightly 92 words per minute during the 10FastFingers.com test with 95% accuracy, which is testament to the layout when my normal average is 88wpm with 91% accuracy. With a large and responsive touchpad underneath, I have no criticisms here.

## Bottom line

The Acer Swift Go 14 makes a strong opening argument for Intel-powered AI PCs. The integrated Arc graphics are a huge step up from before, and



**ABOVE** Improved battery life means the laptop is ideal for life away from the mains

**"The display truly dazzles. There's nothing wrong with the 13.6in IPS panel on the MacBook, but Acer ups the ante in every department"**

while the NPU's value remains unproven there are early signs that it can take on tasks that previously burdened the CPU and GPU.

In particular, the ability to edit 4K videos smoothly, unplugged, and render them quickly on the Acer Swift Go 14 was a revelation.

This level of performance, coupled with its generous 16GB of RAM and 1TB SSD, positions the Acer Swift Go 14 as a compelling alternative to the MacBook Air M2.

It also wins hands down for price: while Apple would argue this isn't a fair comparison, a 13in Air with 16GB of unified RAM and a 1TB SSD costs £1,849.

Even ignoring the marketing spin behind Intel's new chips, its blend of performance, generous memory and storage, aggressive price and great webcam make the Acer Swift Go 14 a serious contender for the hearts (and wallets) of students, content creators and professionals on the go.

**MARK ANTHONY RAMIREZ**



**ABOVE** The superb 14in OLED display and built-in webcam are further highlights

**BELOW** Connectivity options are yet another strong suit

## SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 7 155H processor ● Intel integrated Arc graphics ● 16GB LPDDR5X-6400 RAM ● 14in 90Hz OLED non-touch panel, 2,880 x 1,800 resolution ● 1TB M.2 PCI-E Gen4 SSD ● Wi-Fi 6E ● Bluetooth 5.3 ● 1440p IR webcam ● 2x Thunderbolt 4/USB-C 4 ● HDMI 2.1 ● microSD card reader ● 3.5mm headphone jack ● 65Wh battery ● Windows 11 Home ● 313 x 218 x 14.9mm (WDH) ● 1.3kg ● 1yr RTB warranty ● part code NX.KPOEK.004







## HP Pavilion Plus 14 OLED

Mediocre battery life, but a stunning 14in OLED screen, fast Ryzen chip and a great price compensate

SCORE ★★★★★

PRICE £833 (£1,000 inc VAT) from [hp.co.uk](https://www.hp.co.uk)

**T**he Acer Swift Go 14 (see p48) and this HP Pavilion Plus 14 are resetting our expectations of a laptop costing around £1,000. Top of the list is a high-resolution 14in OLED panel, and with a Ryzen 7 7840 processor, 16GB of RAM and a 1TB SSD, the rest of the headlines specs aren't too shabby either.

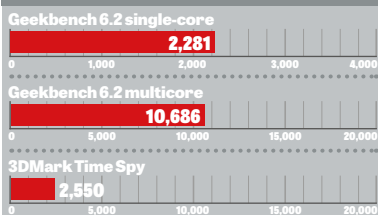
Neither is the aluminium chassis. It might not break stylistic ground and it's a fraction thicker than the Acer, but it looks the part. But we might as well tackle this laptop's biggest problem at the outset: despite having a 68Wh battery, it lasted only 5hrs 48mins in our web-surfing test.

That aside, this laptop shines. The 2,880 x 1,800 OLED panel covers all of the DCI-P3 gamut and beyond, with excellent accuracy: its average Delta E was 0.2. Brightness reached 381cd/m² in our tests, and that increases by around 100cd/m² with HDR content.

The usual superlatives applicable to OLED panels apply here, including vibrant colours and true blacks. But I was disappointed by the bezels around the display. While minimal on the left and right, there's a large bezel at the bottom and another at the top. Given the small size of the webcam, it's a lot of wasted space.

That webcam is packed with features, including a 1440p resolution, infrared sensor and physical privacy shutter. The 5MP webcam itself doesn't live up to the high-resolution billing: its focus was soft, the final image lost detail, the white balance was off and colours looked lifeless. I've seen far superior performance in 1080p webcams.

### BENCHMARKS



### BATTERY LIFE



With my expectations set low, I was then shocked by the quality of the speakers. These are Bang and Olufsen-tuned, complete with DTS:X Ultra audio, and they sound it. There was no distortion even as I cranked the volume to 100%. Bass was lacking, which is to be expected, but otherwise there's nothing to complain about here.

Sadly, my wife did find something to complain about: the sound from the keyboard. I found the clicky keys enjoyable to type on, but the endless "click clack" with every press meant I was soon asked to move to another room. Typing was fast and accurate, however, with our typing speed test returning 84wpm with 95% accuracy compared to the 75wpm and 91% I got on the Samsung Galaxy Book 3 Ultra.

The large, responsive touchpad is top-hinged, meaning pressing toward the top doesn't register input. You have to move down a few millimetres, at which point each press was greeted with a loud, divorce-inducing click.

The eight-core, 16-thread Ryzen 7 7840U remains fast, but it was beaten in all benchmarks by the Ultra 7 in the Acer. Well, all benchmarks bar one: in our Handbrake test it transcoded the video test file in 5mins 40secs, a single second faster. I should also mention that the Ryzen 7 7840U includes an NPU, should that be of interest.

HP makes it easy to remove the bottom panel to repair or replace components, with only four small Phillips screws standing in your way. With those removed, you'll need a plastic spudger or prying tool to create enough of a gap between the bottom panel and the chassis to get a finger or

two in, at which point the bottom panel lifts off.

Only three components are accessible: the battery, the M.2 SSD and the Wi-Fi/Bluetooth combo card. The latter is Wi-Fi 6 rather than 6E.

The LPDDR5 memory is integrated into the motherboard, and you can only configure the system with 16GB. Although "configure" is a strong word here. While there are Intel variants of this laptop, this is the only Ryzen-based option currently available in the UK.

HP has clearly put plenty of effort into the Pavilion Plus 14 OLED, as witnessed by its brilliant 14in 2.8K 120Hz OLED display, high-quality aluminium chassis and surprisingly good speakers. It's a shame, then, that

it's let down by battery life and webcam quality.

It's also unfortunate for HP that we're reviewing the Acer Swift Go 14 OLED in the same month, as for an extra £100 it beats the Pavilion

Plus in almost every area. But that does at least make the buying decision nice and easy. **BRANDON HILL**

### SPECIFICATIONS

8-core/16-thread AMD Ryzen 7 7840U processor • AMD Radeon 780M graphics • 16GB LPDDR5X-6400 RAM • 14in 120Hz OLED non-touch panel, 2,880 x 1,800 resolution • 1TB M.2 PCI-E Gen4 SSD • Wi-Fi 6 • Bluetooth 5.3 • 5MP IR webcam • 2 x USB-C 3.2 Gen 2 • USB-A 3.2 Gen 2 • USB-A 3.2 Gen 1 • HDMI 2.1 • 3.5mm headphone jack • 68Wh battery • Windows 11 Home • 314 x 227 x 17.5-18.9mm (WDH) • 1.4kg • 1yr RTB warranty • part code: 99W99EA#ABU

**ABOVE** The Pavilion Plus 14 OLED has a fine screen, albeit one flanked by large bezels

**"The 2,880 x 1,800 OLED panel covers all of the DCI-P3 gamut and beyond, with excellent accuracy: its average Delta E was 0.2"**

**BELOW** Connections are limited to two USB-A and two USB-C ports



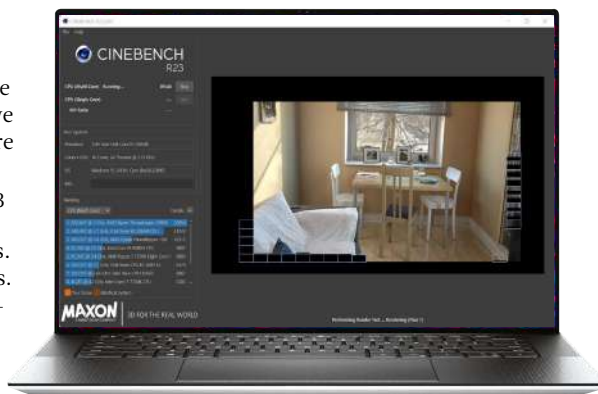
# How we test

## Laptops and PCs

We run a selection of benchmarks on all the PCs and laptops we test. Where possible, we use a cross-platform test so we can compare Windows and macOS machines, which is where both Geekbench and Cinebench R23 come into play. Both push the CPU to its limit, exposing how well cooled a system is.

We run extra tests for Windows systems. We use our own benchmarks to test photo-editing, video-encoding and multitasking speeds. We then switch to PCMark 10 to benchmark systems in office tasks, content creation and basic tasks such as web browsing and video calls. We also run 3DMark Time Spy and a selection of benchmarks in games such as *Metro Exodus* and *Shadow of the Tomb Raider*.

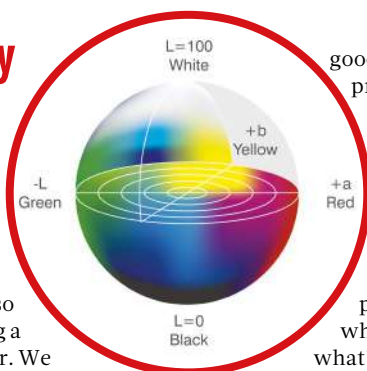
For laptops, we test battery life with Wi-Fi on and the screen brightness set to 150cd/m<sup>2</sup>. We fully charge the laptops and drain them until they reach 5%. For Windows laptops, we will use a mix of PCMark 10's light-use and video-based tests, or a web surfing benchmark where a laptop automatically visits sites until the battery dies. We also use this test for MacBook.



**ABOVE** We put PCs and laptops through our intensive set of benchmarks

## Screen quality

In each laptop, phone, tablet and monitor review, you'll see our conclusions about the screen quality. Some of this will be subjective, but we also test each screen using a Display 11 colorimeter. We measure maximum brightness, colour accuracy and (for monitors) consistency – there may be a difference in, say,



good test of the processor and memory in particular, and include both a test for single-core and multicore performance. See below for a selection of scores to provide a reference of what's good... and what's not so good.

We also run 3DMark Wild Life test to give a measure of gaming performance.

As with laptops, we test phone and tablet battery life by playing a full-screen video until the battery runs out with the device. To simplify the test, we use Airplane mode. We set the brightness to as close to 150cd/m<sup>2</sup> as we can get in the device's settings.

**LEFT** We use a Display 11 colorimeter to measure sRGB gamut coverage and Delta E

**BELOW** We play a video with the screen set to 150cd/m<sup>2</sup> to test battery life



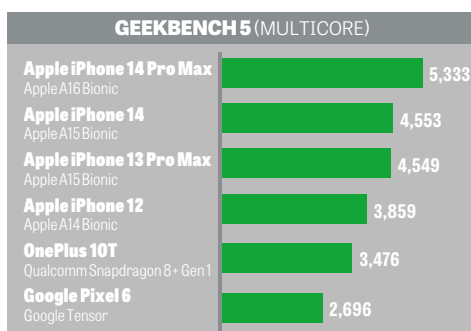
brightness from the middle and the edges of the panel.

We also measure Delta E, which is a guide to how accurately panels display colours.

Anything under 1 is excellent and likely to be difficult for the human eye to distinguish; between one and two is still strong; above this suggests a panel that you shouldn't trust for colour-accurate photo editing.

## Phones and tablets

We run a selection of publicly available benchmarks on all the phones and tablets we review. First, we run Geekbench 5 and 6. These are a



## What our awards mean



### Recommended

This, quite simply, is a product we recommend you buy – if it meets your needs.



### A-List

The best buy in its category right now. The product will also feature on our A-List, starting on p14. It's updated each month.



### Labs Winner

Each month we run a group test, or Labs. This product has managed to beat all others to top position.

## The pcpro.link

Throughout the magazine you'll see pcpro.link shortcuts. Enter these into the address bar of your browser and it will take you to a particular page, which will either be too long or awkward for us to publish or will take you to the precise shop from which to buy. If it's Amazon, note that we have an affiliate deal in place so we will receive a commission from each sale. This will never affect our verdict of a product, and if another reputable vendor is selling the product cheaper than we will use that instead.

## Prices will vary

Prices we publish are correct on the day we publish, but we often see prices change, especially on sites such as Amazon. However, we do work with British PC retailers to ensure the prices we quote for their systems are correct. If the price isn't being honoured, contact us via letters@pcpro.co.uk.





*"The most powerful workstation we've ever tested by a considerable margin"*  
- PC Pro, January 2024, Issue 353

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# Asus ROG Strix Scar 18 (2024)

The Strix Scar 18 now sports a beautiful mini-LED screen, but the 14th gen Intel Core chip fails to make a big difference



**SCORE** ★★★★★

**PRICE** As reviewed, £3,333 (£4,000 inc VAT) from scan.co.uk

**T**he Asus ROG Strix Scar 18 is one of the largest gaming laptops you can buy, and it's just been refreshed for 2024 with a 14th-generation Core i9 processor and a stunning mini-LED screen.

Physically the design hasn't changed from the 2023 version (see issue 344, p54). That means it remains a massive slab of a laptop, with a footprint of 399 x 294mm. It isn't too heavy, though, weighing in at 3kg.

The construction is certainly striking. The aluminium lid has an RGB-backlit logo, with additional colour bars along the front and rear of the chassis, controllable via either Asus' Armoury Crate app or the standard Windows Settings. The rest of the chassis is part-translucent plastic; I

don't love this unfinished look, but it's more interesting than a plain finish.

All the important connectors are present. On the left-hand side are ports for Thunderbolt 4, 10Gbits/sec USB-C (with DisplayPort), HDMI 2.1, 2.5GbE and a 3.5mm audio jack, plus a barrel-style power connector. On the right edge there's an additional pair of 10Gbits/sec USB-A ports. While this should do for most scenarios, it would have been nice to see another Thunderbolt port, perhaps even an SD card reader. It's also disappointing that there's no fingerprint reader; the webcam doesn't support Windows Hello either, so there's no way to log in without a password.

## ■ Gaming skills

The Scar 18 model I tested comes with an all-new Core i9-14900HX processor, an Nvidia GeForce RTX 4090 GPU, 32GB of RAM and a pair of 1TB PCI-E 4 NVMe SSDs. Asus also offers a 64GB option, but you can upgrade the memory yourself and replace the SSDs if you need more storage.

It should be no surprise that the Strix Scar 18 is a stonkingly powerful system. *Cyberpunk 2077* looked amazingly smooth, averaging more than 100fps at the Scar's native 2,560 x 1,600 resolution – and that's using the Ray Tracing Ultra preset with DLSS

Super Resolution enabled, plus DLSS frame generation.

**ABOVE** The striking design will turn heads, as will the price

To see how the Strix Scar 18's gaming skills stack up against the competition, I compared it to three other laptops in the same ultra-premium price bracket: the Alienware m18 R1 (Core i9-13980HX, RTX 4090), the Asus ROG Strix Scar 17 X3D (AMD Ryzen 9 7945HX3D, RTX 4090) and the MSI Titan GT77 HX (Core i9-13950HX, RTX 4090). You'll also find results for last year's Strix Scar 18 in the graphs opposite.

As you can see, the Scar 18 ran all the latest games at very high frame rates, even with the most demanding visual settings enabled – but it didn't

stand out from the crowd, often placing in the middle of the pack. If you're looking for the very pinnacle of performance you'll be better served by the Alienware m18 R1 or the ROG Strix Scar 17 X3D.

**“From gaming to media, and even to simple word processing, everything looks sumptuous on this screen”**

## ■ Productive power

The Scar 18's powerful internals aren't for gaming alone: they should handle any productivity task. Again, though, the Scar 18 didn't stand out in our benchmarks. The CPU-focused Geekbench 5 test saw the Scar 18 in last place, with a single-core score of 1,985; that's a shade below the Alienware, and well behind the AMD-powered Strix Scar 17 X3D's score of 2,139 points. It was a similar story in the Handbrake video-transcoding test, although the Scar's fast SSD enabled it to beat all-comers in our 25GB data transfer test.

**LEFT** The laptop's lid is made from aluminium, but the rest of the chassis is plastic



To keep things in perspective, remember that these rival systems represent the absolute pinnacle of the market. The ROG Strix Scar 18 is still an extremely fast computer. Thermal performance is excellent, too: while running the *Metro Exodus* benchmark with RTX settings, the Scar reached a maximum temperature of only 26°C between the G and H keys, while the touchpad remained at a tepid 20°C. I measured a peak of 39°C on the underside, but in use the laptop never felt more than warm to the touch. And while the fans were audible throughout our tests, they were never too intrusive or annoying.

A laptop like this probably won't be used much away from the mains, but the Scar 18 lasted a solid 4hrs 23mins in our battery test, comprising web browsing, video streaming and OpenGL graphics routines. That's well ahead of the competition: the next longest-lasting gaming laptop was the MSI on 3hrs 48mins, while the Alienware lasted a mere 2hrs 58mins. And if your Scar 18's battery health starts to drop off after a few years, you can simply unscrew the bottom of the chassis and replace it.

## ■ Starry display?

The most significant upgrade to this year's Strix Scar 18 is its mini-LED display, which Asus dubs "ROG Nebula HDR". Gamers will appreciate its 240Hz refresh rate, 3ms response time (grey-to-grey) and Nvidia G-Sync support; there's also an MUX option for the lowest possible latency.

From gaming to media, and even to simple word processing, everything looks sumptuous on this screen. I found myself stopping and staring at the neon signs and brightly lit storefronts in *Cyberpunk 2077*. Space scenes in Christopher Nolan's movie *Interstellar* were like a showcase for the display's HDR capabilities, with stars and spaceships standing out beautifully against an inky black background.

While the display's measured average brightness of 427cd/m² wasn't a match for the MSI's 511cd/m², that doesn't tell the whole story. In our HDR tests the Scar 18 hit a stunning maximum of 1,170cd/m², showing that this mini-LED display can literally outshine its rivals with dazzling HDR performance.

The Strix Scar 18 also didn't beat the MSI in our colour tests, but its 78%

### GRANDTHEFT AUTO V (1080P, VERY HIGH, FPS)

Alienware m18 R1 Core i9-13980HX, RTX 4090	181
Asus Strix Scar 17 X3D Ryzen 9 7945HX3D, RTX 4090	179
MSI Titan GT77 HX Core i9-13950HX, RTX 4090	176
Asus Strix Scar 18 (2024) Core i9-13980HX, RTX 4090	174
Asus Strix Scar 18 (2023) Core i9-13980HX, RTX 4090	152

HIGHER IS BETTER

### SHADOW OF TOMB RAIDER (1080P, HIGHEST, FPS)

Alienware m18 R1 Core i9-13980HX, RTX 4090	192
Asus Strix Scar 17 X3D Ryzen 9 7945HX3D, RTX 4090	188
Asus Strix Scar 18 (2023) Core i9-13980HX, RTX 4090	181
MSI Titan GT77 HX Core i9-13950HX, RTX 4090	180
Asus Strix Scar 18 (2024) Core i9-14980HX, RTX 4090	167

HIGHER IS BETTER

### BORDERLANDS 3 (1080P, BADASS, FPS)

MSI Titan GT77 HX Core i9-13950HX, RTX 4090	177
Alienware m18 R1 Core i9-13980HX, RTX 4090	176
Asus Strix Scar 17 X3D Ryzen 9 7945HX3D, RTX 4090	172
Asus Strix Scar 18 (2023) Core i9-13980HX, RTX 4090	165
Asus Strix Scar 18 (2024) Core i9-14980HX, RTX 4090	141

HIGHER IS BETTER

### FAR CRY 5 (1080P, ULTRA, FPS)

Asus Strix Scar 17 X3D Ryzen 9 7945HX3D, RTX 4090	132
Alienware m18 R1 Core i9-13980HX, RTX 4090	123
Asus Strix Scar 18 (2024) Core i9-14980HX, RTX 4090	116
Asus Strix Scar 18 (2023) Core i9-13980HX, RTX 4090	107
MSI Titan GT77 HX Core i9-13950HX, RTX 4090	102

HIGHER IS BETTER

DCI-P3 coverage is still very good for a gaming laptop.

As for sound, the Scar's twin speakers sit next to the vent holes above the keyboard. Despite their user-facing orientation, when I fired up a playlist I found the sound surprisingly restrained. Changing the Dolby Atmos equaliser to Dynamic boosted the volume and gave bass a pleasing depth, but overall the audio lacks punch.

The speakers work better for gaming. Voices, gunshots and explosions in *Cyberpunk 2077* were all clear, with the only gripe being that I struggled to hear small details over the laptop's fans.

## ■ Pressing matters

The Scar 18's keyboard is quirky. The arrow key cluster intrudes into the main keyboard instead of being separated out, which interferes with the locations of the right Shift and number pad "0" keys. The number pad itself is annoyingly undersized, despite the massive width of the laptop, and the typing action feels surprisingly lifeless. I would have liked a mechanical option, as Alienware offers on its m18.

On the plus side, the five programmable keys at the top left of the keyboard are a great touch.

You can easily create macros for these in the Armoury Crate app, although the option is somewhat hidden away. And the touchpad is excellent, with a

well-sized matte surface and a solid yet quiet, physical click.

The ROG Strix Scar 18's webcam on top of its display has a 720p resolution that will make you feel like you're back in 2010. I expect 1080p at the minimum, preferably 1440p, on a laptop of this calibre. There isn't even a privacy shutter. Asus needs to step up its game here.

## ■ Cons but also pluses

The ROG Strix Scar 18 isn't the fastest gaming laptop on the market. Connectivity isn't much to write home about either, and the complete absence of biometric features is poor form for a system costing this much.

Even so, it will tear through every game you care to throw at it – and they will look fantastic thanks to the huge, gorgeous mini-LED screen. That makes this system a very appealing desktop replacement, with the added bonus of impressive battery life. If you want to eke every possible frame out of your games then look elsewhere, but if you're someone who appreciates the overall visual experience then the ROG Strix Scar 18 demands serious consideration. **CHARLES JEFFERIES**

### SPECIFICATIONS

24-core (8 P-cores, 16 E-cores) Intel Core i9-14900HX processor • 16GB Nvidia GeForce RTX 4090 graphics • 32GB DDR5-5600 RAM • 18in non-touch mini-LED display, 240Hz, 2,560 x 1,600 resolution • 2x 1TB M.2 Gen4 SSDs • Wi-Fi 6E • Bluetooth 5.3 • 720p webcam • Thunderbolt 4 • USB-C 3.2 Gen 2 • 2x USB-A 3.2 Gen 2 • HDMI 2.1 • 2.5Gb Ethernet • 3.5mm combo jack • 90Wh battery • Windows 11 Home • 399 x 294 x 23.1mm (WDH) • 3kg • 1yr limited warranty • part code: G834JYR-R6019W

**ABOVE** Excellent cooling means the Scar 18 can run at full pelt without problems

**LEFT** The gorgeous mini-LED screen makes games and films look stunning





## Acemagic S1 mini PC

The 1.9in LCD display lifts this above mini PC rivals, but we think it's most at home as a file storage server

SCORE ★★★★★

PRICE \$279 from [acemagic.com](https://www.acemagic.com)

**A**cemagic positions the S1 as an entry-level mini PC for home and office users. With its compact design, 16GB of RAM and 512GB SSD of storage, it's well tailored for low-impact day-to-day tasks. But it could serve you even better as a router/firewall in a small office or home network, or as a file storage server if you upgrade to the 1TB version for an extra \$20.

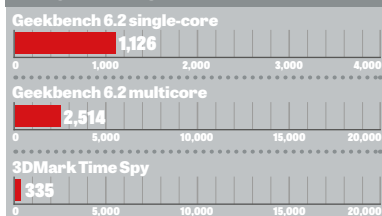
You may not even need to hook it up to a monitor, as its standout feature is a 1.9in LCD screen. By default, this displays the CPU's power consumption, temperature and load, along with the memory load and fan speed. (It tells you the time and date, too.)

I've tested numerous mini PCs and while this can be said to be an "extra" feature rather than a necessary one, it's definitely welcome. It not only adds a futuristic element to the design but also provides functional real-time system monitoring depending on what you're doing with the machine. You can also delve into the preinstalled app and tailor what's displayed, but it's all based on system monitoring so don't expect too much.

Performance-wise, the S1's Intel Processor N95 – based on Intel's 12th generation Alder Lake-N, so think Atom levels of speed – can handle basic tasks with relative ease. However, with only four single-threaded cores, you'll quickly realise it wasn't built for intensive work.

Similarly, if you're looking for gaming potential the S1 won't be for you, with the N95 scoring an exceptionally modest (some would say poor) 335 in 3DMark Time Spy

### BENCHMARKS



**ABOVE** The 1.9in LCD screen is a useful addition to this PC

due to its ageing Intel UHD Graphics. It can, however, competently handle older, less graphically demanding games, so if you're a fan of retro titles then it will cope.

Despite these bottlenecks, you'll find that the S1 doesn't skimp on connectivity, featuring dual gigabit Ethernet support. That's not only handy for redundancy, but makes a lot of sense if you want to use the S1 as a router or firewall. This, alongside the Wi-Fi 6 and Bluetooth 5.2, places the S1 right at home in modern office setups.

In terms of design, the S1 is a compact machine, featuring magnetic detachable casing that ensures upgrades and repairs are easy. The single DIMM socket is filled with 16GB of DDR5 memory, so if you want to go up to the maximum 64GB then you'll need to replace it. There's

better news on the storage front, with a second M.2 SSD slot (albeit SATA) to accompany your choice of 512GB or 1TB M.2 NVMe SSD.

Where you may be disappointed is in the choice of plastic rather than metal in the construction, even if this doesn't detract aesthetically from the PC. And there's one big benefit, too: the Acemagic S1 is phenomenally light, weighing in at just under 400g.

Underneath the casing you'll find all the components are cooled with copper pipes and a bottom ventilation design, maintaining low noise levels. This makes it perfect for a

shared workspace. The form factor is another highlight. Designed to fit neatly on a desktop or even a shelf, the S1 can be placed either horizontally or vertically. The screen cleverly rotates too. The bundled magnetic base is another welcome addition, offering a solid base for the PC to stand on to maximise stability.

Where the S1 leaves something to be desired is its port selection. The highlight is having two HDMI ports, making it possible to connect two 4K displays, but only four USB ports overall (an even split between USB-A 2 and USB-A 3.2 Gen 1) is disappointing. Note the lack of USB-C in particular. And fans of wired headphones may be distressed to learn that the audio jack is placed awkwardly on the back of the PC, having been placed there with speakers in mind.

Priced at \$279 for the 512GB version and a mere \$299 for 1TB, the S1 offers incredible value, especially with free worldwide shipping when you buy from its website (it isn't available from UK retailers). If you want to add your own storage, a scout on Amazon reveals that a 512GB M.2 SATA SSD costs around £30.

In terms of specs, the Acemagic S1 is nothing to write home about, but thanks to a competitive price, versatile design and low noise levels, it's a great choice if you want a basic office PC. Where there's greater

promise, though, is in a networking role thanks to the dual LAN ports, giving the LCD a role as a quick diagnostics check for your server.

**ALASTAIR JENNINGS**

**"Dual gigabit Ethernet support is not only handy for redundancy, but makes a lot of sense if you want to use the S1 as a router or firewall"**

### SPECIFICATIONS

4-core Intel Processor N95 processor • 16GB DDR5-5600 RAM • Intel UHD Graphics • 1.9in LCD display • Wi-Fi 6 • Bluetooth 5.2 • 2 x 1GbE ports • 512GB/1TB M.2 NVMe SSD • 2 x USB-A 2 • 2 x USB-A 3.2 Gen 1 • 2 x HDMI 2 • 3.5mm jack • 41 x 124 x 128mm (WDH) • 380g • Windows 11 Pro • 3yr warranty

**LEFT** The two gigabit Ethernet ports are accompanied by twin HDMI sockets

**BELOW** The versatile design means the S1 can be used in a wide range of situations







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by **iiyama**



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# Samsung Galaxy S24 Ultra

Genuinely useful AI, seven years of updates and unparalleled hardware make this our top choice for the most demanding users

SCORE ★★★★★

PRICE 12GB/256GB, £1,041 (£1,249 inc VAT) from [samsung.com/uk](https://samsung.com/uk)

**S**amsung is marketing the Galaxy S24 Ultra as the AI phone to beat in 2024. From the Circle to Search feature to discovering what plant is growing in your garden to Chat Assist translating messages in other languages, the Galaxy AI features all aim to simplify your life.

But: the Galaxy S24 Ultra costs £100 more than the S23 Ultra (see *issue 343, p68*), while replacing that phone's 10x optical camera with a less powerful but sharper 50MP 5x telephoto lens. So is this a mis-step or AI-assisted brilliance?

## Galaxy of AI features

First, let's consider Circle to Search. This is a Google initiative that will be rolled out to other phones, and it aims to make search easier if you see something in a photo. A long press of the home button allows you to circle the object or subject with your finger, and the corresponding search results page will pop up as an overlay. For example, I saw a photo posted by a friend on Instagram of a car that I didn't recognise. With Circle to Search, I selected it while still in the app and it showed me search results of what it could be.

Built into the Samsung keyboard, Chat Assist can help you craft a message using the right tone. Think of it as an assistant who can tailor your

messages so you sound professional when typing emails to the boss. It works, but I had to chuckle at how formal it made me sound. I can't imagine using it much.

Live Translate is a different matter. This turns the Galaxy S24 Ultra into a translator during phone calls and supports 13 languages. I tried it with a colleague who speaks Spanish and quickly noticed that you have to be as basic, formal and slow as possible, as the AI needs time to understand what's being said and then translate it to the appropriate language to the person on the other end of the line. This latency can be confusing, but I like how the translated conversation is displayed on the screen. It even works in third-party apps such as WhatsApp, matching Google's Pixel phones, saving you the hassle of copying and pasting messages into another translation app.

I'm also thrilled that the Galaxy S24 Ultra can make sense of my messy and disorganised S Pen-scrawled notes thanks to Notes AI. The autoformat

feature adds appropriate bulleted headlines and short descriptions, resulting in a cleaner list. It looks like a personal secretary wrote it all up.

The final useful Galaxy AI feature is the Voice Recorder app. Much like the one in Google's Pixel phones and third-party services such as Otter.ai, it can transcribe recordings, label individual speakers and even summarise everything into a TLDR-styled bullet list. It's an invaluable tool for meetings.

**ABOVE** The S24 Ultra is the best high-end Android phone around



**"I'm thrilled that the Galaxy S24 Ultra can make sense of my messy and disorganised S Pen-scrawled notes thanks to Notes AI"**

## Zoom controversy

Despite ditching the 10x optical zoom, the S24 Ultra has a formidable set of camera specs. There's a main 200MP camera (with

60% larger pixels), 12MP ultrawide camera, 10MP telephoto lens with a 3x optical zoom and a 50MP telephoto camera with a 5x optical zoom.

While Samsung says the S24 Ultra delivers the same optical-quality performance as its predecessor, the truth is more nuanced. At 5x zoom, the S24 Ultra is the clear winner over the S23 Ultra due to its overall brighter composition and warmer colour temperature. Things get more interesting at 10x zoom, because the S24 Ultra leans on the larger sensor of its 5x telephoto camera and new



**LEFT** The Galaxy S24 Ultra's AI editing tools can transform photos

image processing to try to match the S23 Ultra's 10x optical range. It's close, but the S23 Ultra still pulls ahead on detail. The difference becomes even more obvious once you further increase the zoom.

With video recording, however, the S24 Ultra's 5x telephoto camera matches the detail captured by the S23 Ultra's 10x telephoto camera. Both are excellent video cameras due not only to their zoom but also manual controls that let you fine-tune the settings.

On the main camera, details remain plentiful, colours are vivid and its HDR performance nicely evens out highlights and shadows. The 12MP ultrawide camera has the same 120° field of view and quality levels as before, capturing eye-catching, bright scenes, but I prefer the S24 Ultra's portraits due to its warmer handling of skin tones, along with how the background blur is intensified. By comparison, the S23 Ultra's portrait mode shots appear muted. It's a tough call against the iPhone 15 Pro Max (see issue 351, p62): while I like the higher contrast look of the S24 Ultra's portrait mode, the iPhone's colours and blurring effect are more realistic.

## AI camera boost

Arguably the biggest gains for the camera relate to the Galaxy AI editing tools. To start, there's Edit Suggestion. Its most notable option is to remove reflections from glass surfaces, which can be a painstaking process when done manually. With Edit Suggestion, I simply tapped the option and, after a few seconds of analysing the photo, the reflection was gone.

Taking a page out of Google's playbook, the S24 Ultra gains its own Magic Editor tools to manipulate photos with its Generative Edit. In this mode, you can select a subject and then reposition or resize it anywhere in the photo – and the phone fills in the blank spaces with generative AI. The end result is highly convincing, even if it takes a few seconds to complete. Generative Edit can also take crooked photos and make them straight, realistically filling blank spaces in the image.

But I think I'll use the new Instant Slow-mo feature more than the rest combined, because it can convert any video I record and turn it into a slow-motion clip. It's hard to tell the difference with real slow-mo (which the camera can, of course, shoot).

## Design tweaks

There's a reason I've focused so much on software, as the hardware is little changed from the S23 Ultra. Most notably it ditches the Armor

How the Galaxy S24 range compares			
	Galaxy S24	Galaxy S24 Plus	Galaxy S24 Ultra
Starting price	£799	£999	£1,249
Screen size	6.2in	6.7in	6.8in
Storage options	128GB, 256GB (£859)	256GB, 512GB (£1,099)	256GB, 512GB (£1,349), 1TB (£1,549)
Rear cameras	50MP/12MP/10MP	50MP/12MP/10MP	200MP/12MP/10MP
Optical zoom	3x	3x	5x
Front camera	12MP	12MP	12MP
Battery	4,000mAh	4,900mAh	5,000mAh
Dimensions	71 x 7.6 x 147mm	76 x 7.7 x 159mm	79 x 8.6 x 162mm
Weight	167g	196g	232g

All prices inc VAT from [samsung.com/uk](https://www.samsung.com/uk)

Aluminium frame for a titanium one, which increases durability and lightens the phone by 10g.

Samsung has also reduced the size of the bezel at the bottom of the display, but perhaps the biggest visible change is the choice of colours. I'm particularly taken by the titanium violet option.

The S24 Ultra also marks the end of the era for curved screens. I always liked this sleek aesthetic, but Samsung says it meant the S Pen was more likely to slip over the edge. When not in use, the S Pen tucks neatly away in a slot at the bottom of the phone.

The screen itself gets some minor upgrades. It now peaks at 144Hz, and Samsung promises a peak brightness of 2,600cd/m<sup>2</sup>, but as ever our testing couldn't reach these heights. Still, its 1,353cd/m<sup>2</sup> when displaying HDR content was a fraction higher than the 1,225cd/m<sup>2</sup> of the S23 Ultra. Other than that, it's as you were – and that means a gorgeous AMOLED panel with a ludicrously high resolution.

## Turbo boost

All versions of the Galaxy S24 series are powered by the Snapdragon 8 Gen 3. The S24 Ultra is one of four phones this month to feature the chip, and Samsung has squeezed the most out of it: for example, it scored 2,308 and 7,283 in Geekbench 6's single-core and multicore tests respectively, easily exceeding its predecessor (2,091 and 5,511). It even beats the A17 Pro powering the iPhone 15 Pro Max in the multicore test (2,890 and 7,194).

**ABOVE** The entire S24 range features the new processor and Galaxy AI

**"All versions of the Galaxy S24 series are powered by the Snapdragon 8 Gen 3, and Samsung has squeezed the most out of it"**

**BELOW** The S24 Ultra has a formidable set of cameras



Even more impressive is its graphics performance, setting records with 3DMark's Wild Life Unlimited test. Its 20,627 score is over 2,000 better than the Asus ROG Phone 8 Pro (see p62), while the iPhone 15 Pro Max trails in at 15,399. Games that support ray tracing take obvious advantage, with *Diablo Immortal* producing smooth frame rates despite the extra demands. It also remained cool during my extended *Diablo* sessions, thanks to improved thermal control that features a vapour chamber almost double the size of the S23 Ultra's.

The new Snapdragon chip works wonders for battery life, too. In our rundown tests, the S24 Ultra kept going for 16hrs 45mins compared to 10hrs 3mins for the Pixel 8 Pro and 14hrs 2mins for the iPhone 15 Pro Max. That's despite Samsung keeping the same 5,000mAh battery as before.

There's only one disappointment, which is that charging speeds remain the same: 45W wired, 15W wireless. With the former, the phone goes from zero to 71% in 30 minutes.

## Ultra good

Although I would have liked more updates to One UI, which is little changed, it's arguably more important that

Samsung now promises seven years of security and OS updates, matching Google's offering on the Pixel 8 series.

This, together with the Galaxy AI features, a marked increase in processing power and battery life, plus the minor but all-round improvements in the hardware, make this a big upgrade over the Galaxy S23 Ultra. My only disappointment is that the camera feels like it has stayed still – with the

zoom, it's arguably gone back a step. But unless you were constantly shooting at 10x zoom or higher, there's no doubt this is now the premium phone to beat. **JOHN VELASCO**

## SPECIFICATIONS

8-core Qualcomm Snapdragon 8 Gen 3 SoC • 12GB RAM • Adreno 750 graphics • 6.8in 120Hz AMOLED screen, 1,440 x 3,120 resolution • 5G • 256GB/512GB/1TB storage • quad 200MP/50MP/10MP/12MP rear cameras • 12MP front camera • Wi-Fi 7 • Bluetooth 5.3 • NFC • 5,000mAh battery • USB-C 3.2 Gen 2 • Android 14 with One UI 6.1 • Samsung S Pen • 79 x 8.6 x 162mm (WDH) • 233g • 1yr warranty





## OnePlus 12

The biggest update to OnePlus' top-end phone for years turns it into a serious flagship contender

SCORE ★★★★★

PRICE 12GB/256GB, £708 (£849 inc VAT)  
from [oneplus.com](https://oneplus.com)

OnePlus is on the up. First it surprised us late last year by nabbing the folding phone crown from Samsung with the OnePlus Open (see issue 351, p60); now the OnePlus 12 is resetting expectations for premium phones.

It starts with aggressive pricing. At £849 inc VAT with 12GB of RAM and 256GB of storage, this phone is a little pricier than the OnePlus 11 (see issue 343, p72), but it's a whole lot cheaper than the Google Pixel 8 Pro (see issue 351, p70) and, of course, the Samsung Galaxy S24 Ultra (see p58).

There's also a maxed-out version with 16GB of memory and twice the storage, and for an introductory

period it's only £50 more than the base model at £899. The official price is £999.

As an extra sweetener, if you buy from OnePlus then you can also claim a free gift – at the time of going to press, a set of OnePlus Buds Pro 2, which retail for £179.

### ■ Tweaks to the design

The OnePlus 12 keeps the same overall aesthetic as the OnePlus 11, and I'm fine with that. There's something about the circular camera hump on the back of the phone, combined with the metal trim sides and textured casing, that just looks cool and upmarket. The textured exterior minimises smudges, while



the relatively narrow shape makes it easy to grasp with one hand.

There are a few minor changes to the OnePlus 11 design, notably the repositioning of the silent switch to the left side. Unexpectedly, OnePlus has also included an IR transmitter on the top edge of the phone, allowing it to double up as a universal remote.

My only reservation about the OnePlus 12's design is that it's more top-heavy than its predecessor. This isn't a dealbreaker, but it made me more cautious about handling the phone, mainly because I have the suspicion that an accidental drop won't end well. That said, with Corning Gorilla Glass Victus 2 in place, my fears are hopefully ill-founded.

The screen is fantastic for the price. It's a 6.8in "ProXDR" display – that being OnePlus' take on HDR – with an enormous native resolution of 1,440 x 3,168. The manufacturer claims it can reach an unheard-of peak brightness of 4,500cd/m<sup>2</sup>, and while I can't vouch for that precise figure – the highest figure we measured was 865cd/m<sup>2</sup> – I can confirm that it dishes up strong brightness and contrast, even in direct sunlight.

A 120Hz refresh rate ensures everything flows smoothly, making games and apps look beautifully fluid, and OnePlus doubles down on that metaphor with a new feature called Aqua Touch. It claims this ensures accurate touch detection even if the

ABOVE Four fantastic cameras and a superb screen make the OnePlus 12 a great buy



**"The screen is fantastic for the price. It's a 6.8in "ProXDR" display with an enormous native resolution of 1,440 x 3,168"**

LEFT The design is no great departure, but it looks upmarket

RIGHT A transmitter on the top allows the phone to double up as a universal remote

phone's screen is wet – great if you like to bring your phone into the shower to scroll through your feeds or play a few tunes.

Previous OnePlus phones have often come up short for camera quality when compared to flagship rivals. The OnePlus 12 breaks that record: it includes a Hasselblad-branded camera system, comprising a main 50MP camera, a 48MP ultrawide unit and a 64MP periscope camera with 3x optical zoom. The main sensor is bigger, the image-processing software has

been overhauled, and by just about every measure it's a significant improvement on what's gone before.

### ■ Picture perfect

Starting with the 50MP main camera, I was delighted to see how my pictures came out with sharp detail, realistic colours and good dynamic range. The 48MP ultrawide camera also holds up well, especially in high-contrast scenes with strong sources of light. Both perform nicely in portrait mode, doing a fine job of blurring the background while retaining fine detail around the edges of the subject.

The front-facing camera is also great for self-portraits, capturing

strikingly realistic skin tones. I found my face looked noticeably more natural than it did with the OnePlus 11.

But the biggest news is the 64MP periscope camera. This bumps up the phone's optical zoom capabilities to 3x, from 2x on the OnePlus 11 – but the improvement isn't only about magnification. The 3x zoom photos I captured with the OnePlus 12 were unquestionably sharper and more



detailed than anything I could capture with the 2x zoom camera of the OnePlus 11, but if you want to get even closer then the phone also offers a 6x in-sensor zoom option. This basically crops in on the centre of the frame, but since the native resolution of the sensor is so high, you still end up with lovely clean images.

If I had to complain I'd note that the OnePlus 12 has a tendency to underexpose low-light scenes, and give them a warm colour cast. They're not too noisy, though, so you can potentially make them punchier in post-processing.

Video recording, meanwhile, is another strong suit. The OnePlus 12 captures plenty of detail and offers decent exposure adjustment and zoom options, up to the maximum possible 18x zoom level. I wish it offered preset zoom options, as the slider is fiddly – but since you can optionally shoot at 8K, it's possible to reframe your footage in post by cropping down to a 4K resolution. Switch to Pro mode and you can adjust the shutter speed, focus and ISO level. It's also possible to choose a flat colour profile, so you can do your own grading later on.

Overall, the OnePlus 12's camera setup is a big step up from last year's model. The one thing it's missing is AI: you won't find smart image-optimisation features like the ones on the Google Pixel 8 Pro or the Samsung Galaxy S24 series.

## ■ Turn of pace

The OnePlus 12 has considerable processing muscle, courtesy of the latest Qualcomm Snapdragon 8 Gen 3 chipset. Basic operations such as scrolling through the interface and running apps all feel impeccably tight, and graphics performance is exemplary. I measured a wickedly fast 117fps in the 3DMark Wild Life Unlimited test – beating the iPhone 15 Pro (see issue 351, p62) – while graphically intensive titles such as *Diablo Immortal* ran flawlessly.

Surprisingly, though, the OnePlus 12 lagged in Geekbench, scoring 943 and 4,859 respectively in the single-core and multicore tests. Those are respectable scores, but they're not on a par with Apple or Samsung's latest phones. Never mind: in actual usage I didn't detect the slightest hint of sluggishness.

Besides, I have far more important news for long-term OnePlus fans: after a baffling two-year absence, wireless charging has finally

returned. The OnePlus 12 can charge at up to 15W on a standard Qi charging pad, or at the ridiculous rate of 50W using OnePlus' proprietary Airvooc charger. This can revive a completely dead phone to full charge in less than 50 minutes – faster than anything else on the market.

Not that recharging is a major concern. The OnePlus 12's 5,000mAh battery, combined with the power efficiency of

**BELOW** Graphics performance is up there with the best flagship smartphones



**LEFT** On the back are a 50MP main camera, a 48MP ultrawide and a 64MP periscope lens



Qualcomm's latest processor, easily gets me through a working day without the need to recharge. On average, I found it ended up at about 25% capacity by bedtime, so there's a reassuring amount of juice to spare.

## ■ Clean air

OnePlus' take on Android is called OxygenOS, and it delivers a clean, modern-looking interface with a few neat custom features, such as the

## ■ Only pluses

The OnePlus 12 may sound like just another annual update, but it's one of

**“The OnePlus 12 may sound like just another annual update, but it's one of the biggest upgrades to OnePlus' flagship offering in years”**

**BELOW** The textured exterior minimises smudges, and Gorilla Glass Victus 2 protects the screen

smart customisable sidebar for quick access to apps. To add intelligence, OnePlus has borrowed AI features from Google; notably Magic Compose, which uses generative AI to write messages and emails for you.

OnePlus also plans to introduce a feature called “Emojify” to create emojis by analysing your profile picture or snapshots of your pets. It remains to be seen how useful this feature will be. Otherwise, there's little that's new in OxygenOS 14, compared to the previous iteration. I'm surprised, because OpenPlus introduced several handy features with the OnePlus Open, such as its unique Open Canvas multitasking. I had hoped for a similar level of innovation here, but perhaps that will come in a future OS release.

the biggest upgrades to OnePlus' flagship offering in years. With the reintroduction of wireless charging and improved camera capabilities, it feels like the manufacturer has convincingly put to rest the most common grumbles about its phones.

I won't deny I'm disappointed by the lack of AI features. It's clear that that's the way technology is heading, and OnePlus hasn't kept up with the big smartphone names – Google and Samsung in particular. That's why the Galaxy S24 Ultra wins an A List award this month rather than the OnePlus 12. Even so, it's

impossible not to like this phone, especially since it manages to work in so many improvements while keeping the price sharply competitive. **JOHN VELASCO**

## SPECIFICATIONS

8-core Qualcomm Snapdragon 8 Gen 3 SoC • 12GB/16GB RAM • Adreno 750 graphics • 6.8in 120Hz AMOLED screen, 1,440 x 3,168 resolution • 5G • 256GB/512GB/1TB storage • triple 50MP/64MP/48MP rear cameras • 32MP front camera • Wi-Fi 7 • Bluetooth 5.4 • NFC • 5,400mAh battery • USB-C 3.2 Gen 2 • Android 14 with OxygenOS 14 • 76 x 9.2 x 164mm (WDH) • 220g • 1yr warranty







## Asus ROG Phone 8 Pro

Asus smooths some edges and adds a zoom lens to give this gaming phone far more appeal than before

SCORE ★★★★★

PRICE 16GB/512GB, £917 (£1,100 inc VAT) from rog.asus.com

**T**he ROG Phone 7 Ultimate (see issue 350, p64) was arguably the best gaming phone of 2023, but at £1,200 for the 512GB version Asus was asking a considerable price. Even though the ROG Phone 8 Pro is £100 cheaper, the same criticism applies – more so if you opt for the 24GB RAM/1TB variant for £1,300.

But one thing has changed. With the release of the ROG Phone 8 Pro, Asus has accepted that even gaming phones should look and feel relatively normal. The “Dare to win” decals are still present, albeit now subtly rendered in dark writing, while Asus’ AniMe system on the back of the phone lets you program LED effects or display information such as the phone’s charging status and incoming notifications.

Another welcome feature is IP68 certification. Finally, a gaming phone that won’t quit if you drop it in a body of water! What’s more, in radically reducing the size of the Asus ROG Phone 8 Pro’s bezels, it’s almost 10mm shorter than its predecessor. One sacrifice is the previous ROG Phone’s front-firing speakers. Here, you’ll find speakers in the earpiece and on the bottom edge of the phone, but I tended to block these when I held it in landscape orientation.

Two vital gaming design elements have been retained. One is a set of Air Triggers, which are dedicated capacitive buttons on the edge of the phone. These come in handy in competitive shooters and racing games, and can even be split into two for a total of four controls.

The other retained gamer-friendly feature is a secondary USB-C port on the long edge of the phone opposite the Air Triggers. This makes for a much more pleasant experience when you’re playing landscape games.



And there’s still a 3.5mm headphone jack for low-latency audio.

The phone also has an updated 6.8in OLED display. With a 1,080 x 2,400 resolution it loses out in the numbers battle compared to other phones at this price, but I’ve no complaints in terms of sharpness. It’s a great screen: it covers the entire DCI-P3 gamut with superb accuracy (average Delta E was 0.31). It also hit a high maximum brightness of 1,637cd/m².

In everyday use, the display scales up to 120Hz. Head into gaming mode, however, and it can ramp up to 165Hz. There aren’t many games that will step north of 120Hz, but the ROG Phone 8 Pro is ready for any that try.

So how fast will this phone go?

The first signs are excellent, with Qualcomm’s Snapdragon 8 Gen 3 chipset the go-to choice for Android flagships in 2024. Geekbench 6.2 returned a multicore score of 7,079 in “X Mode”, which beats both the RedMagic 9 Pro opposite and the iPhone 15 Pro (see issue 351, p62).

Where the ROG Phone 8 Pro falters compared to its RedMagic

rival is in sustained performance. After a 20-minute session of repeating loops, the ROG Phone 8 Pro’s frame rates at the end were 92.2% of where they started. That’s consistent, but the RedMagic 9 Pro returned a nigh-on

perfect 99.7% due to its superior cooling: when I attached the optional (£72) AeroActive Cooler X to the back of the ROG, it scored 98.3% in the same test.

The other downside is that you’ll have an extremely toasty phone by the end of the workout, which brings me to battery life. I feared this would be a problem here, as Asus moved from a 6,000mAh battery in the ROG Phone 7 Ultimate to 5,500mAh in the 8 Pro, but my fears were quashed by an 18hrs 48mins time (with the adaptive refresh rate on) in our custom battery life tests. That’s 4hrs 34mins more than the 7 Ultimate and puts this phone second only to the RedMagic Pro 9. What’s more, the supplied 65W charger got me from empty to 100% in around 40 minutes.

The ROG Phone 8 Pro also has an ace up its sleeve in the form of 15W wireless charging, which is yet one more feature that makes this the easiest gaming phone to live with. And here’s another: a vastly improved

50MP main camera with a gimbal stabiliser, plus a 3x optical zoom on the 32MP camera. These helped it produce well-exposed and detailed shots in a range of lighting conditions, including night mode. I

was a disappointed by the 13MP ultrawide, though, which can’t match the main unit for tone or detail.

Switch to video and you can shoot at up to 8K/24fps or 4K/60fps, although the “Hyper Steady” mode is only available at 1080p/30fps.

While it may fall short of the RedMagic 9 Pro when it comes to sustained gaming performance, the ROG Phone 8 Pro is still a formidable gaming beast. But what truly lifts this phone apart from its gaming rival – along with a more pleasant and intuitive user interface – is that it’s a true all-rounder. **JON MUNDY**

### SPECIFICATIONS

8-core Snapdragon 8 Gen 3 processor • 16GB/24GB RAM • Adreno 750 graphics • 6.8in 120Hz AMOLED screen, 1,080 x 2,400 resolution • 5G • 512GB/1TB storage • dual nano-SIM • triple 50MP/32MP/13MP rear cameras • 32MP front camera • Wi-Fi 7 • Bluetooth 5.3 • NFC • 5,500mAh battery • 2 x USB-C ports • Android 14 with ROG UI • 77 x 8.9 x 164mm (WDH) • 225g • 1yr warranty

**ABOVE** The ROG Phone 8 Pro has an understated design for a gaming phone

**“Another welcome feature is IP68 certification. Finally, a gaming phone that won’t quit if you drop it in a body of water!”**

**LEFT** The 50MP main camera is equipped with a 3x optical zoom and gimbal stabiliser

**BELOW** The AeroActive Cooler X is effective, but costs an extra £72



## RedMagic 9 Pro

The latest Qualcomm chip and heaps of gaming extras make this a fine choice for gamers on a budget

SCORE ★★★★★

PRICE 12GB/256GB, £483 (£579 inc VAT) from uk.redmagic.gg

**S**ay what you like about the RedMagic 9 Pro gaming phone, but you can't question its value. While the equivalent Asus ROG Phone costs north of £1,000, RedMagic is asking £579 for the 9 Pro with 12GB RAM and 256GB of storage, or £709 for the 16GB/512GB editions. So what do you lose out on?

At first glance, very little. It has a headphone jack on its top edge, while the aluminium sides house a red Game Space slider for accessing the phone's gaming tools alongside the usual power and volume controls. The back of the RedMagic is flat aside from the flash module, meaning that while it's thicker than a "normal" phone, it stays stable when laid flat.

Colour choices are tied to the phone's memory/storage variants: plain black for the 12GB/256GB model, silver or transparent for the 16GB/512GB edition. Opting for the clear back reveals a carbon fibre-esque substrate containing RedMagic branding and an extra Snapdragon 8 Gen 3 logo, reminding you what's powering the phone. And it's to RedMagic's credit that it is one of the first to use Qualcomm's latest generation chipset, alongside LPDDR5X RAM and UFS 4 storage to keep things running at full pelt. Then there's RedMagic's own Red Core 2 Pro gaming chip, providing support for the phone's gaming extras.

However, don't expect radical frame rates. When testing the RedMagic 9 Pro in games such as *Asphalt 9: Legends* and *Grid: Autosport*, I found it (and the Asus ROG Phone 8 Pro) mostly offered similar performance to the Samsung Galaxy S23 Ultra (see issue 343, p68), which uses the older Snapdragon 8 Gen 2. Where the RedMagic phone excels is with its consistency. Thanks to built-in fans, I saw no drop-off even when playing



**ABOVE** The RedMagic 9 Pro is a speedy phone for the price

*Genshin Impact* on max settings. Even the Asus ROG Phone 8 Pro can't match it for consistent frame rates, unless you buy the £1,300 version with its external fan.

RedMagic OS 9 remains marred by poor translation; everything you need is there, but it's hard to spot at first glance. Where things get more interesting is when you slide the red switch on the right side to open up the Game Space. This is a dedicated launcher from which you can install plugins to customise your gaming experience, such as the capacitive shoulder triggers, which boast improved sweat resistance and enhanced sensitivity. These can even be programmed to "tap" whichever area of the screen you set them to, essentially having the phone behave like a gamepad.

The RedMagic's single USB-C port includes HDMI support and up to 120Hz refresh rates. Add a Bluetooth controller and you've got yourself a portable games console, especially if you install game-streaming apps such as Xbox Game Pass or PlayStation Remote Play.



**"The single USB-C port includes HDMI support. Add a Bluetooth controller and you've got yourself a portable games console"**

**LEFT** The transparent back on the 16GB edition reveals additional branding

Thanks to RedMagic's cooling fan, the phone's body never gets uncomfortably hot during gaming. With a huge 6,500mAh battery inside, it outlasted the ROG 8 Pro by over an hour in our tests, putting it right at the top of our table with 19hrs 57mins. Using the included 80W wired charger I got the phone from 0% to 44% in 15 minutes and 100% in 42 minutes, but there's no wireless charging support.

The rest of this phone is premium without being exceptional. A 6.8in OLED panel with a 120Hz refresh rate and peak 1,600cd/m<sup>2</sup> brightness (according to RedMagic; our testing didn't reach these heights) are great. And while a 1,116 x 2,480 resolution sounds low, it looks sharp. With snappy 960Hz touch sampling, little will get in the way of a smooth gaming experience.

For durability, the RedMagic 9 Pro's screen has a Gorilla Glass 5 display panel – not the most recent Victus 2, but still something to shrug off damage. Unfortunately, because of the holes in the body required for the cooling, there's no water or dust resistance rating.

There are fewer cameras on the RedMagic 9 Pro than its predecessors. Its total camera count is a lowly three, consisting of 50MP main and 50MP ultrawide cameras on the back, plus the 16MP selfie camera hidden under the display on the front.

While the cameras are better than previous RedMagic phones – other than the selfie camera, which produced flat, overbright results – they still don't excel for

detail or colour balance. If this is a priority, consider the similarly priced Google Pixel 8 (see issue 351, p72).

For photography, as in so many other areas, the Asus ROG 8 Pro is victorious, but let's once again look at the price. If you're after a fast gaming phone for less than £800, it's a great choice. **RICHARD FRIDAY**

### SPECIFICATIONS

8-core Snapdragon 8 Gen 3 processor • 12GB/16GB RAM • Adreno 750 graphics • 6.8in 120Hz AMOLED screen, 1,116 x 2,480 resolution • 5G • 256GB/512GB storage • dual nano-SIM • dual 50MP/50MP rear cameras • 16MP front camera • Wi-Fi 7 • Bluetooth 5.3 • NFC • 6,500mAh battery • USB-C 3.2 Gen 2 • Android 14 with RedMagic OS 9 • 77 x 8.9 x 164mm (WDH) • 229g • 2yr warranty





# Join us for the weekly PC Pro podcast

Every week the team gives its hot take on the news and delivers a verdict on the hot hardware. With a rotating cast of Tim Danton, Jon Honeyball, Darien Graham-Smith, Barry Collins, Lee Grant and Rois di Thuama, you're guaranteed informed opinions and many appalling jokes.

**WHEN?** Live every Thursday at 1pm

**WHERE?** Discord: visit [pcpro.link/discord](https://pcpro.link/discord)

**RSVP?** No need, just join us!

The PC Pro podcast is available from Apple Podcasts,  
Spotify and all good podcast apps.

## Solos AirGo 3 Smart Glasses

By focusing on AI assistance rather than portable displays, these are the first smart glasses we can recommend

SCORE ★★★★★

PRICE Argon, £167 (£200 inc VAT) from [solosglasses.com](https://solosglasses.com)

**W**e've seen a rush of smart glasses in recent months, with the Ray-Ban Meta Smart Glasses (see issue 352, p71) the most high profile. While US firm Solos might not be as famous, its range of AirGo 3 frames are arguably the pick of the bunch. Not only do you get ChatGPT access through a single touch of the temple, and impressive media playback through surprisingly decent speakers, but there's real-time language translation, too.

You can choose from three frame designs: Xeon sunglasses (from £160), Argon eyeglasses (from £200) and Helium sports glasses (from £160). The modular construction means you can disconnect the temples and fit new frames to them if bought separately from the Solos Glasses website, allowing you to mix and match styles. While plain lenses are free, you'll need to pay extra for prescription lenses.

I tested the Xeon 5 AirGo 3 model, which looks similar to a classic Wayfarer frame. They look like any other glasses from most angles and similar to the Ray-Bans. Solos stashes the electronics in the chunky temples, but they're light and seamlessly blend in with the overall style of the rims. A pair of beamforming mics hide in the right temple, and thanks to noise-reduction technology they're superb at capturing voices: despite a mumbling habit, not once in my month-long test did they struggle to recognise my prompts, even on bustling streets. They're great for phone calls, too.

The right-hand side of the frames holds touch-sensitive virtual switches. A shallow groove acts as a virtual volume rocker, with a swipe towards or away from the ears raising and lowering the device's volume.

Next to this is a small bump that can be tapped or held to engage the AirGo 3's mics and capture audio prompts or turn the device on or off.

While these virtual buttons are responsive and rarely misjudge an input, they can be hard to locate. Even after a month, I'd still misplace my digits while trying to press one of them, often accidentally engaging the wrong action in the process.

Thankfully, the frames themselves act as a virtual button, able to register single, double and triple taps to interact with a connected smartphone. A quick single tap across the frames can play and pause media, while a triple tap bypasses SolosApp's digital assistant to engage with your phone's own.

Paired with the beamforming mics, these quick inputs give an impressive hands-free experience. I was never once left holding my temple while shouting aloud in public as passers-by crossed streets to avoid the man yelling into the void about playing conspiracy podcasts on Amazon Music.

As the temples branch off they narrow into soft coated tips that don't rub or wear against the ear over long stretches of use. Just before the curve around the ear are twin semi-open ear speakers that direct audio into your ear. These speakers

can get surprisingly loud, and can be adjusted in-app to enhance the sound of voice or music playback.

At low volumes these speakers will gently beam your favourite tunes into your ears in a fairly imperceptible-to-others manner in outside settings.

However, as the volume increases, so does the level of audio bleed. You'll get the most out of these speakers when you're free to crank up the volume, with their surprisingly clear and crisp audio.

Praise must also go to Solos for its well-rounded introduction via the Solos AirGo App. You'll soon become acquainted with its three primary modes: SolosChat, SolosTranslate and the Solos AI Coach. SolosChat connects to ChatGPT, and once you

activate it (by touching the frames as instructed) you say your prompt and, within moments, your chosen AI avatar will respond, either through the temple-housed speakers or through text in the SolosApp chat window. Each interaction feels fluid, and I soon found myself asking it questions rather than Googling.

SolosTranslate is a ChatGPT-powered real-time translation tool, which captures audio through the mic array and converts it into your language of choice in text or audio form. It can even translate your speech into a different language (also useful for eavesdropping!). The speed and accuracy of its translation is outstanding, and similar to that offered by the Samsung Galaxy S24's Live Translate feature (see p58). Not only will SolosTranslate capture the spoken word, but it will write it out, adjusting as it goes based on context. Once it's done capturing a speaker, the translation is genuinely near-instant, and audio playback in your

preferred language kicks in at the exact same time.

Finally, AI Coach is a health tracker that can record steps taken, calories burnt through exercise, and can even help to promote better

posture through the IMU (Inertial Measurement Unit) motion sensors housed within the frames. While it can't match the health-tracking metrics of a smartwatch, it still has plenty of valuable insights into how active you are throughout the day.

Solos' AirGo 3 Smart Glasses genuinely feel like a glasses 2.0 moment. While they don't incorporate the portable display tech of smart glasses such as the Xreal Air 2, they do provide exactly what a pair of glasses should: focus. With a real-world battery life of beyond ten hours when streaming music (two days if just asking occasional questions), fantastic AI-enhanced software and a modular design, the AirGo 3 gets our full backing. **RAEL HORNBY**

### SPECIFICATIONS

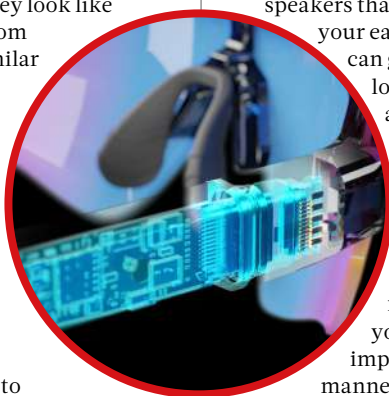
2 x microspeakers • beamforming mic array • Bluetooth 5.2 • IP67 • weight and dimensions depend on frames • compatible with Android 8 and iOS 13 and above • 1yr warranty

**ABOVE** The AirGo 3 look like normal glasses, and come with a choice of frames



**"The ChatGPT-powered real-time translation tool captures audio through the mic and converts it into your language of choice"**

**LEFT** The electronics are stashed in the chunky temples





# Your bonus software

Total value  
this month  
**£133**

We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

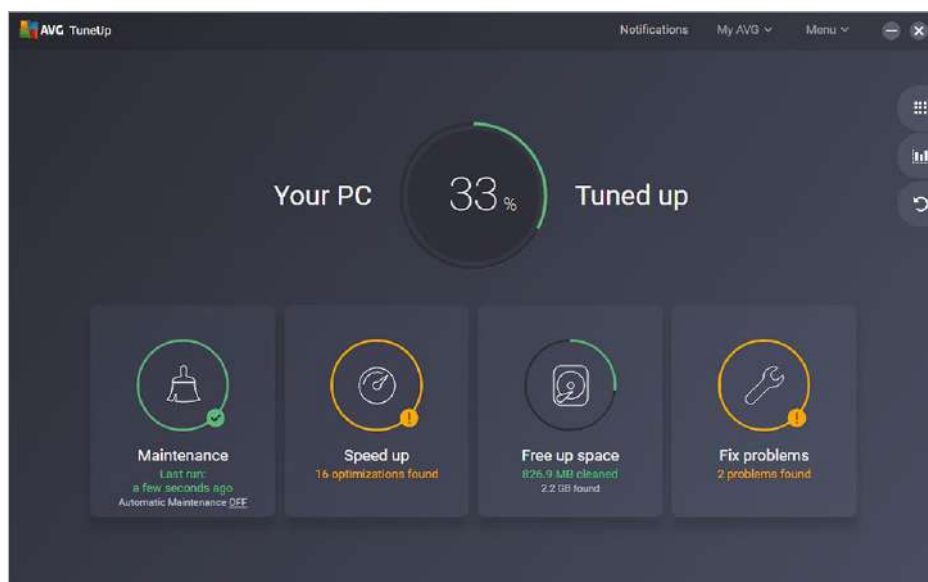
## AVG TuneUp 2024

AVG TuneUp can handle all your PC maintenance needs – and we don't just mean the usual “empty temporary folders and clear your browser history” routines.

The suite cleans up after major applications, locates duplicate files, removes bulky startup programs, warns about software that could slow down your PC, deactivates unnecessary processes, optimises battery life, suggests speed-up opportunities and much more. If you're the hands-on type then you can take full control; if not, the program can do most of its work automatically.

The Disk Doctor module will scan your drives for errors and report not only what should be fixed but how it should be repaired. If you need to safely erase sensitive data, you can select files and folders and AVG Shredder will wipe them securely, so they can no longer be recovered. Meanwhile, the junk remover makes space for what really matters by removing clutter from your disk. AVG TuneUp knows exactly where programs tend to litter your drive, and can find useless data with a simple scan.

■ **10-device, one-year licence worth £45**  
■ **avg.com REQUIRES Windows 8 or later; 200MB hard drive space; online registration**



There's also a comprehensive System Information module and a powerful Registry Editor with which advanced users can delve deep into the Registry to solve potential issues. You can also optimise your PC with Sleep Mode, which suspends background programs, scheduled tasks and processes, waking them up only when you need them. When you've finished using them, they'll be frozen again, so they don't drain resources that could be better employed elsewhere.

The integrated software updater will scan your system and check for new versions of installed software, then either notify you or automatically

patch and update in the background. Not only will this ensure you have access to the latest features in your favourite programs, it can also help to keep your PC secure by fixing any vulnerabilities before they're exploited.

The results of all of these tweaks speak for themselves. In AVG's own measurements, TuneUp can improve startup times by 79% and help your computer run up to 30% faster. And, should anything go wrong, there's no need to panic: the Rescue Center module tracks every tweak, optimisation and update, so you can quickly undo any changes and go back to a previous state.



**ABOVE** If background services are slowing down your PC, TuneUp can put them to sleep whenever they're not required



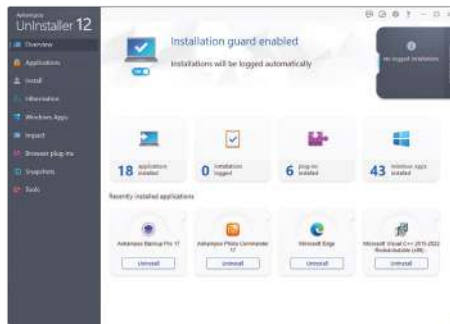
**ABOVE** After scanning your PC and drawing up a list of problems, TuneUp lets you choose whether to fix or ignore each one



**ABOVE** Once your chosen optimisations and fixes have been applied, you can review your changes and see what effect they're having on your PC

## Ashampoo Uninstaller 12

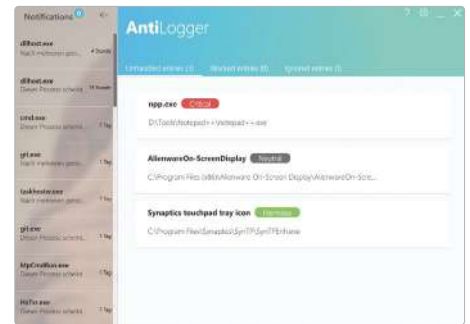
- Remove stubborn applications from your PC; locate and delete associated files and leftover Registry keys
- Compare system snapshots to show which changes are made when an application runs
- Includes bonus PC optimisation tools, including internet history wiper, disk defrag, secure file wiper and more



■ Full product worth £35 ■ [ashampoo.com](http://ashampoo.com)  
**REQUIRES** Windows 8 or later; 100MB hard drive space; in-application registration

## Abelssoft AntiLogger 2023

- Specialist anti-malware tool to detect and remove keyloggers, which monitor and record everything you type
- No bulky interface or manual controls: launch the program and it immediately checks all running processes
- Lists all running programs and indicates which processes might be malicious



■ Full product worth £18 ■ [abelssoft.net](http://abelssoft.net)  
**REQUIRES** Windows 10 or later; 50MB hard drive space; in-application registration

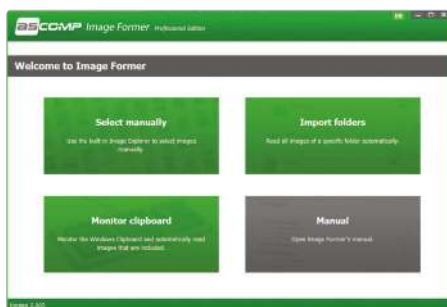
## Audials Music 2024 SE



■ Full product worth £10 ■ [audials.com](http://audials.com)  
**REQUIRES** Windows 10 or later; 250MB hard drive space; in-application registration

- Find your favourite tracks online, then stream or download them to your computer
- Combine your local and online music libraries
- Search for audio tracks and music videos, and add songs to your collection for playback later

## Ascomp Image Former 2



■ Full product worth £15 ■ [ascomp.de](http://ascomp.de)  
**REQUIRES** Windows 7 or later; 50MB hard drive space; in-application registration

- Batch editor to simultaneously apply a standard set of changes to a collection of photos
- Rotate, apply colour correction, crop and more
- Use naming rules to create new copies of your images or update your originals

## IObit Malware Fighter 11 Pro



■ One-PC, six-month licence worth £10  
■ [iobit.com](http://iobit.com) **REQUIRES** Windows 7 or later; 70MB hard drive space; online registration

- Scan on demand for spyware, adware, Trojans, bots and other threats
- Smart Scan option quickly checks the most critical areas of your PC
- Real-time protection for running applications

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**2** Once you're in the download area, you can access this month's bonus software by navigating to the relevant product page and clicking the red Install button. For trial software, freeware and other downloads, click the Install button below the product description, or follow the onscreen instructions (please make sure to read these carefully).

**3** If the software needs registering, click the purple Register button, or follow the instructions on the left of the product page (again, please read these carefully). In some cases, you may need to register for a PC Pro software store account – if you don't already have one – and you might be prompted to reenter the coupon code on the spine or cover.

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# Nvidia GeForce RTX 4070 Super

On a par with the RTX 3080 but in a more compact package, the 4070 Super is your best option at this price

SCORE ★★★★★

PRICE £483 (£579 inc VAT) from [store.nvidia.com](https://store.nvidia.com)



Looking at the AMD GPUs, overall the RTX 4070 Super comes close to matching the RX 7900 XT. An impressive feat considering it uses about 100W less power, has a significantly smaller die size, comes with 40% less VRAM – and costs £150 less. Against AMD's next step down, the RX 7800 XT,

The RTX 4070 Super is the first "refresh" of Nvidia's 40-series to land, with the 4070 Ti Super and 4080 Super due to arrive shortly. The newcomer provides higher specs and better performance than the plain RTX 4070, and also pushes the price of that card down to £529.

In our tests, it's about 15% faster than the RTX 4070. That means you're getting equivalent performance to the previous generation RTX 3090 for less than half the cost. And, with a 192-bit interface and 12GB of VRAM, it's a memory match for the 4070 Ti.

In terms of key specs, you get the same 2,475MHz boost clock as the RTX 4070, but with 22% more cores and a 10% higher total graphics power (TGP). Just be aware that the 4070 Super uses the 16-pin power connector, so if you don't have an ATX 3.0 power supply you'll have to use the ugly adapter cable.

Other than the stealthy colour scheme, there are no significant design changes relative to the existing 4070 Founders Edition. You get the same triple DisplayPort 1.4a and single HDMI 2.1 outputs, dual fans with one on each side of the card, and the angled heatsink fins that have been used on the past two generations of

Founders Edition cards. I have no complaints as I liked those designs, and the slightly higher TGP is well within the cooling capabilities of the heatsink and fans.

So, on to the tests. Our current suite consists of 15 games. Of these, we enable DirectX Raytracing (DXR) in six. The remaining nine games are tested in pure rasterisation mode. While many of the games in our test suite support upscaling, primarily via DLSS 2, our focus is primarily on native resolution performance.

At 1080p, the 4070 Super is overkill for games that don't use ray tracing: it averaged 200fps in our test suite when we excluded such games. Add ray tracing and things look very different. Here, the 4070 Super averaged 77fps with top quality settings, on a par with the RTX 3080 and Radeon RX 7900 XT, with (for example) a 95fps average in *Control* and 63fps in *Cyberpunk 2077*. This drags its overall average down to 124fps in the graph below.

Moving to 1440p, the standings are as you'd expect. The RTX 4070 Super is 16% faster than the vanilla 4070, and comes in 7% behind the 4070 Ti. I'd be surprised to see anything else, considering the specs.

**ABOVE** The RTX 4070 Super is a cost-effective upgrade for keen gamers

the 4070 Super delivers 24% more performance for 20% more money.

Switch to 4K ultra and we need to talk about DLSS. If we were only looking at rasterisation performance, the superior bandwidth and VRAM capacity puts the 7900 XT clearly ahead of the RTX 4070 Super. Not that it's slow. Most games – including *Borderlands 3* and *Far Cry 6* – still break 60fps, *A Plague Tale: Requiem* averaged 42fps without DLSS, though, and *Flight Simulator* dropped to 50fps.

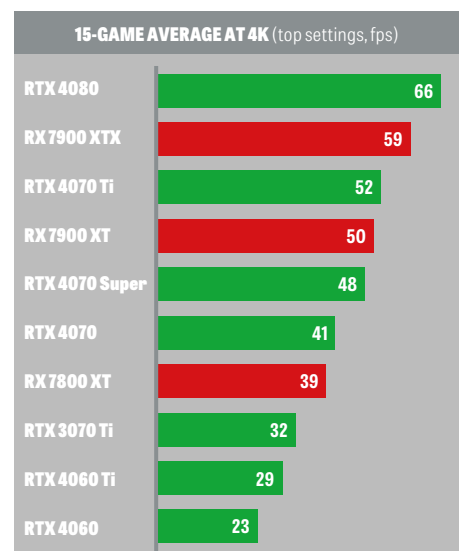
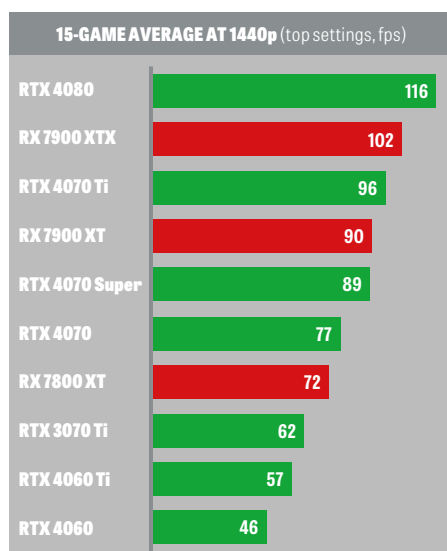
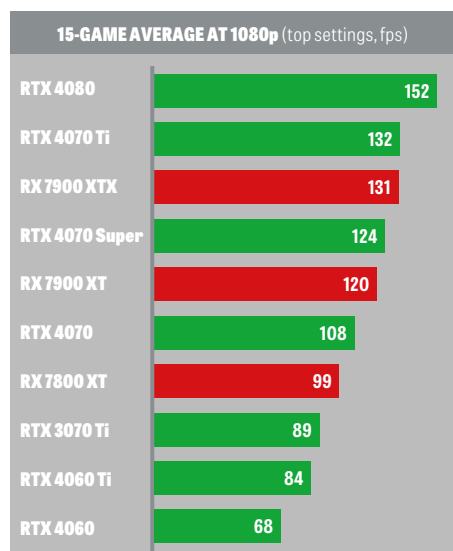
If you're in the market for a new graphics card that costs around £500 to £600, the RTX 4070 Super is now the best option. In fact, given the choice, I'd take the 4070 Super at £579 over the RX 7800 XT at £499, even though it doesn't have as much memory.

JARRED WALTON

**"If you're in the market for a new graphics card that costs around £500 to £600, the RTX 4070 Super is now the best option"**

## SPECIFICATIONS

PCI-E Gen4 x16 graphics card • 1.98GHz base clock, 2.48GHz boost clock • 7,168 CUDA cores • 56 SMs • 224 tensor cores • 56 RT cores • 12GB GDDR6X memory • 192-bit memory interface width • 3 x DisplayPort 2 • 2 x HDMI 2.1 • 220W • 244 x 112mm (length x width) • 2yr limited warranty



Test rig: Core i9-13900K with all cards upgraded with latest drivers

Key: Green = Nvidia cards Red = AMD cards

## IS TITANIUM



£499.99

CPU Intel Core i5 11400  
MOB ASUS PRIME H510M-A  
RAM 8GB DDR4 2666Mhz  
SSD 240GB Sata3 SSD  
HDD 1TB Sata3 HDD  
OPT 24x DVD RW Dual Layer  
GPU Intel Integrated HD630  
CAS Fractal Core 1100  
PSU 500W PSU  
O/S Windows 10/11 64Bit

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RAM 16GB DDR4 3200Mhz  
SSD 1TB WD SN770 M.2 Gen 4  
GPU NVIDIA RTX3070 8GB  
CAS GAMEMAX F15M MESH  
PSU 750W Gold PSU  
O/S Windows 10/11 64Bit

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CPU Intel Core i5 12400  
MOB ASUS PRIME B660M-A WIFI D4  
RAM 16GB DDR4 3200Mhz  
SSD 2TB ADATA Legend 800 M.2  
GPU Intel Integrated HD730  
CAS KOLINK Stronghold  
PSU 500W PSU  
O/S Windows 10/11 64Bit

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GPU AMD Radeon Graphics  
CAS 1stPlayer D3-A  
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## WD Red Pro 14TB

Performance could be better, but it's difficult to argue with the resilience of this NAS drive

SCORE ★★★★★

PRICE £318 (£381 inc VAT) from broadbandbuyer.com

Until SSDs match the capacities and price-per-gigabyte of hard disks, there will always be a place for our mechanical friends. That's especially true for NAS appliances, which is precisely what Western Digital's Red Pro series is designed for.

This means the focus isn't on the fastest possible performance, but on maximum endurance and low power consumption. There's a wide range of capacities on offer, from 2TB up to 22TB, but the 14TB model hits a sweet spot between low cost and capacity. It uses eight high-density platters, which spin in a sealed helium enclosure to minimise resistance, heat build-up and vibrations.

If you don't live in an earthquake zone that last feature might seem superfluous, but it can provide protection against accidental bumps and drops. The drive also incorporates WD's 3D Active Balance Plus technology, which we've previously seen on

Enterprise-class drives. This is designed to avoid resonance synchronisation, where ordinary usage patterns cause the drives to all vibrate together, causing unwanted wear and noise. It also tracks shock events in real-time and makes tiny height adjustments to the head to ensure it doesn't physically crash into the recording surface.

Thanks to all these technological assurances, WD rates the drive for workloads up to 550TB/year at an operating temperature of 40°C. That's backed up with a five-year warranty, and a quoted mean time between failure of 2.5 million hours. That works out to around 285 years of uninterrupted use, which might

seem excessive, but this is a statistical measure rather than a countdown. If a company's using 100 of these drives, it should expect to see one failure every 2.85 years on average – although real-world failures probably won't be perfectly evenly spaced out.

While the priority is reliability, WD hasn't neglected performance. The WD141KFGX is a 7,200rpm drive with a generous 512MB of cache – twice as much as is included on the 12TB and smaller models. On our test unit this came in the form of a Samsung-made DDR3 chip, but given the vagaries of the DRAM market that could change in future versions of the drive.

To see what difference this makes, we used a variety of benchmarks to compare the performance of the 14TB disk to the WD120EFBX Red Plus 12TB drive – a cheaper option with a three-year warranty and a rating of 180TB/year. The graphs to the left make it obvious which is faster.

Bear in mind that overall performance will depend on the number of drives in the array and the network interface. If you're accessing a NAS over a regular gigabit Ethernet connection then your transfers will be capped at around 110MB/sec, so you shouldn't expect to see much difference between the 14TB WD Red Pro and a cheaper drive. However, the



ABOVE The Red Pro is a durable drive that's designed for NAS use

LEFT Capacities on offer range from 2TB up to a massive 22TB

faster Pro will still have an advantage when rebuilding an array or copying data over a fast USB interface.

The WD Red Pro also benefits from WD's TLER feature – short for "Time-Limited Error Recovery". This means that, when a read error is encountered, the drive only briefly tries to recover the data before simply marking the sector as unreadable. This keeps things running smoothly and prevents the NAS host from registering the drive as unresponsive. As long as the drive is being used in a RAID configuration no

data should be lost, as the corrupted information can be reconstituted from other drives in the array.

The power consumption of the drive is low, considering the number of platters and the amount stored on each one – we measured around 6.2W under load, and less than half of that when inactive.

At £318 exc VAT the WD141KFGX is pricey, although it's better value than, for example, the 12TB option, which only costs £15 less. There are cheaper options from other manufacturers, though: shop around and you can find the 14TB Seagate IronWolf Pro for less than £300, while the 14TB Toshiba N300 can be bought on Amazon for £230 exc VAT. The key differences are that the Seagate and Toshiba drives each have only 256MB of cache, and

are rated for lesser workloads than the WD – 300TB per year for the Seagate, and only 180TB per year for the Toshiba.

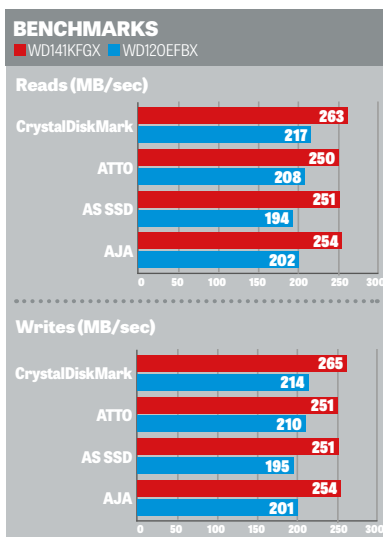
Whether that makes a difference depends on your needs. For a typical

SMB file server, a cheaper drive will probably be resilient enough, and the savings will stack up when populating a NAS with multiple drives.

However, for a busy professional environment where data is continually flying back and forth over a multi-gigabit network, WD's Red Pro series has the edge on performance, while its industry-leading endurance rating provides plenty of reassurance on the reliability front. **MARK PICKAVANCE**

### SPECIFICATIONS

2TB to 22TB 3.5in hard drive ● SATA III 6Gbits/sec ● 7,200rpm ● up to 255MB/sec sequential transfer speeds ● 550TB annual workload ● 2.5 million hours MTBF ● 102 x 25.4 x 147mm (WDH) ● 5yr limited warranty



# bbCloud: simplified security for your business

**Rather than juggle several security solutions, switch to broadbandbuyer's hassle-free cybersecurity-as-a-service**

**R**ansomware. Data breaches. Phishing campaigns. Cyberattacks on small businesses came thick and fast in 2023, with 32% of UK businesses facing cyber breaches or attacks. Even worse, SMBs are now subject to enterprise-grade attacks of ever-increasing sophistication. If staying safe seems like a constant firefighting battle, broadbandbuyer has the solution: bbCloud.

Put simply, bbCloud delivers cybersecurity-as-a-service. Created by broadbandbuyer, it integrates with WatchGuard's cloud platform and latest appliances, customised to meet your unique security needs. The emphasis is on best configuration security practices, meticulously pre-configuring devices to align with your requirements.

Once deployed, bbCloud actively monitors your network with built-in threat detection, along with fine-tuning network configurations to maintain an optimal security posture. You'll also benefit from advanced reporting tools and dashboards, so you can stay ahead of threats and make informed decisions. It's a hassle-free solution that's perfect for those seeking robust network security without the high costs.

## ■ Choose your level

With bbCloud, the sweet spot is CaaS, where you get the appliance with the Cybersecurity service included. Alternatively, HaaS enables you to simply rent the hardware. It's worth noting that CaaS can be set up in line with your company's expertise, having your in-house IT teams making their own changes, or getting total peace of mind with broadbandbuyer taking complete control for you.

## ■ Flexible payments

You can choose a 12-month subscription, payable annually or in monthly instalments. The service comes bundled with either WatchGuard Basic Security or Total Security, with options to add on EPDR and AuthPoint Total Identity Security. This combines multi-factor authentication with dark web monitoring and a corporate password manager.



Broadbandbuyer's registered trade customers will benefit from discounts up to 50% off the standard pricing of £119 per month, which includes a preconfigured WatchGuard firewall.

## ■ Easy steps

As part of the bbCloud service, broadbandbuyer will pre-configure and dispatch WatchGuard appliances. When they arrive, it's a simple plug-and-play setup. Need more fine-tuning? No problem: simply consult with the WatchGuard certified engineers to tailor the units to your specific security and networking needs.

## ■ Scalability

During your subscription term you'll be able to upgrade your firebox to the latest model, or even move down the scale if you wish, so your tabletop appliance is never below the spec you need, nor overkill.

## ■ AI-refined attacks

Inevitably, the rise of AI-powered tools will fall into the wrong hands, with cybercriminals using them to make their attacks ever more sophisticated. So it's a wise move to let broadbandbuyer's experts become your experts. They stay vigilant, constantly analysing alerts and monitoring trends to keep your network secure.

Their capabilities include interpreting intricate dashboards and generating insightful reports, which can be pivotal in identifying staff training needs and preventing security breaches through user awareness.

To simplify security for your business, put the strength of your network in the hands of the well-informed staff at bbCloud.



**Explore bbCloud cybersecurity at [www.broadbandbuyer.com](http://www.broadbandbuyer.com)**





## Creality Ender-3 V3 SE

An entry-level 3D printer that benefits from Creality's extensive industry experience and proven track record

SCORE ★★★★★

PRICE £158 (£189 inc VAT)  
from store.creality.com

**T**he Creality Ender-3 V3 SE is the perfect 3D printer for beginners. With an easy-to-use interface, direct drive extruder and on-screen guide, it helps you through every step of the process. Combined with a low price, there's little more a beginner could ask for: with a fair wind, you can go from unboxing to printing in less than 30 minutes.

As far as features go, the Ender-3 V3 SE is relatively barebones. It has the same bed-slinger design as other budget 3D printers, and some premium models, allowing a clear view of the internal print workings. This has two benefits: it gives novices the hands-on experience they need, and makes it easier to identify issues such as loose belts.

Assembly of the Ender-3 V3 SE is incredibly simple. It comes almost fully assembled out of box aside from the attachment of a frame and the plugging in of some wiring. When it comes to printing, it differs from most by opting for a dial to operate the LCD rather than a touchscreen, which goes with the "what you see is what you get" design philosophy and provides a pleasingly retro feel to the machine.

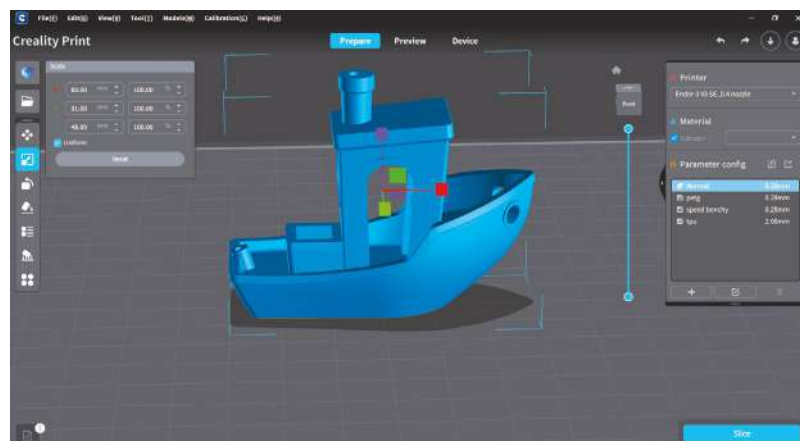
The Ender-3 V3 SE measures 365 x 345 x 458mm and weighs 6.5kg, making it compact and portable. The filament is mounted on top of the machine, taking up vertical space but contributing to its small footprint, so it will be right at home on any desk or workspace.

Alongside impressive speed and a high-power processor, the Ender-3 V3 SE's auto-levelling is a standout feature, thanks to the CR Touch sensor that simplifies achieving a perfect first layer. This feature, along with the strain sensor for auto Z offset, ensures precision and ease in print setup, making it a hassle-free experience for users regardless of expertise level.

The Ender-3 V3 SE impressed in our tests, especially considering its position as an entry-level model. Such exceptional performance is testament to its simple design, and it excels in dimensional accuracy (a crucial aspect of precision in 3D printing). With an average error of only 0.054mm, it demonstrates an ability to reproduce dimensions almost perfectly. This precision makes it suitable for detailed models and prototypes where exact measurements are essential.

**ABOVE** Setting up and operating the Creality Ender-3 V3 SE is incredibly simple

**"With an average error of only 0.054mm, it demonstrates an ability to reproduce dimensions almost perfectly"**



**LEFT** The printer's precision makes it ideal for detailed models and prototypes

It also scored extremely well in overhangs and bridging, with both tests receiving a perfect score. This reflects the printer's capability to handle complex geometries and structures without support. Where it faltered was in fine flow control and XY resonance, suggesting limitations in handling intricate details and

potential vibrations during high-speed prints; you'll need to slow down the pace to achieve the best results.

Proper filament management is crucial for this printer. Using a filament dryer, as recommended, can notably enhance print quality. However, the lack of a filament run-out sensor means users should be vigilant, especially when undertaking larger prints.

When it comes to print speed, while there is a decline in quality at maximum speeds, the prints remain acceptable. This flexibility is beneficial for rapid prototyping or test prints before committing to longer, more detailed print sessions that may be more befitting of a final piece.

The printer operates at a moderate noise level, which, while noticeable, is not overly disruptive, making it suitable for home or small office environments. Plus, its fast operating speed means any noise won't be a nuisance for long.

The Creality unit is a highly capable entry-level 3D printer. Its blend of simplicity, advanced features and reliable performance make it an excellent choice for beginners and those looking for an affordable yet capable 3D printer.

A key factor contributing to its appeal is the exceptionally accurate auto-bed levelling system, which consistently ensures reliable and

high-quality prints. This, coupled with its straightforward setup and operation, makes it an attractive option for those new to 3D printing. The printer's ability to handle various filaments with

ease, further boosted by the use of a filament dryer, enhances its versatility. While it lacks advanced features such as filament run-out sensors, this doesn't detract from its overall quality. When it comes to value for money, you really can't find any 3D printers better than this.

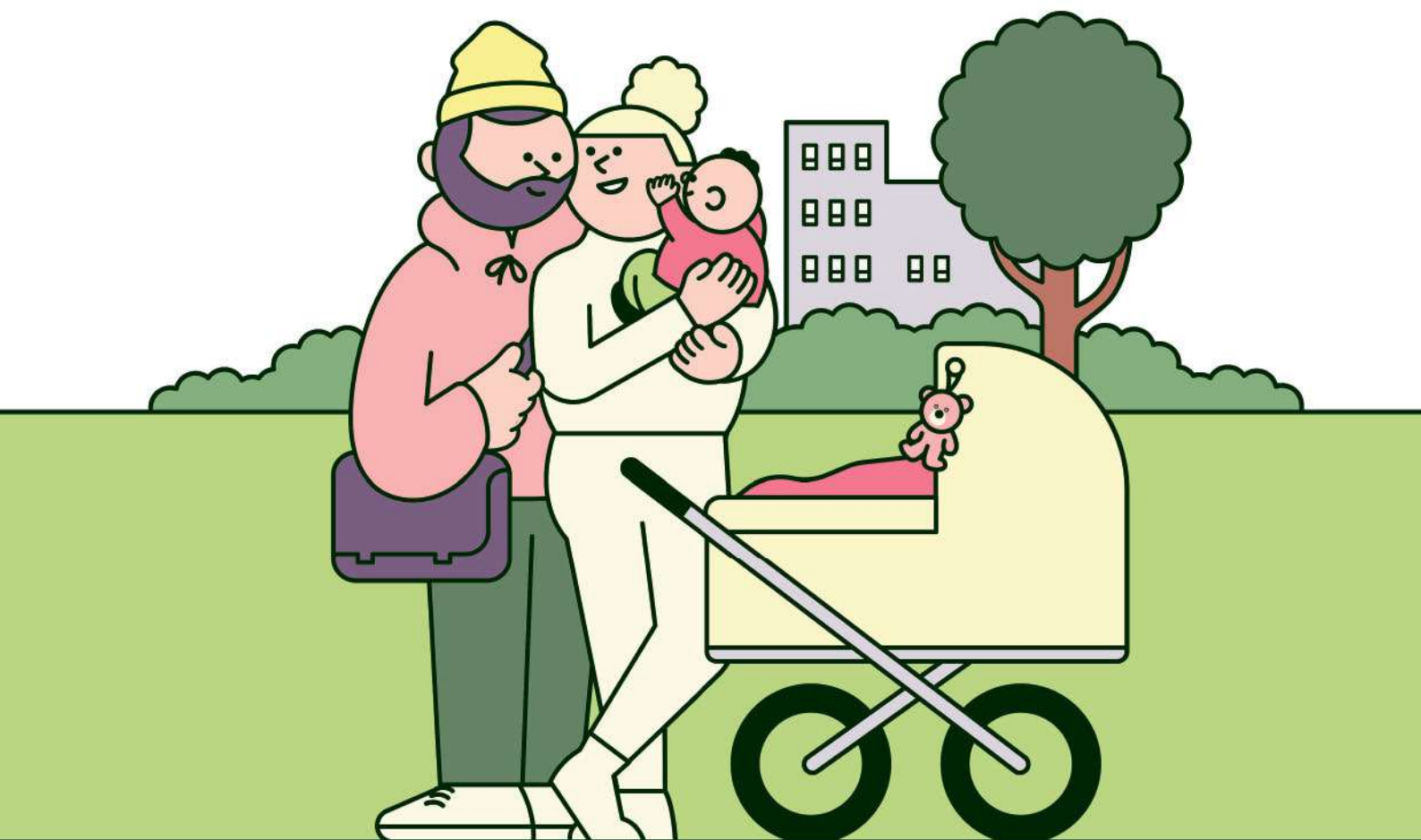
### SPECIFICATIONS

Fused deposition modelling (FDM) • up to 250mm/sec print speed • 3.2in LCD • 220 x 220 x 250mm • supports PLA, PETG, TPU (95A) • 365 x 345 x 458mm (WDH) • 6.5kg • 1yr limited warranty



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Photoshop Elements 2024 is the latest edition of Adobe's popular consumer version of Photoshop, and we have a deal that will save you £27 from its normal £86.99 price and give you two licences. And don't worry if you're a Mac user: simply select the Mac version of the software for the same price.

The program is built around Sensei AI technology, which takes the hassle out of editing by providing a series of "guided edits" to simplify popular tasks. That could be automatically colourising old black and white photos, replacing backgrounds to add more vibrancy, or making one-click selections of awkwardly shaped objects.

Throw in tools for removing unwanted objects and combining two shots into a single photo, and the sky is

almost literally the limit (speaking of which, you can easily replace that too if it's dull and uninspiring).

One major new feature is the ability to transform a static photo into a moving image with one click. This makes use of both 2D and 3D camera motion, again powered by Adobe's Sensei AI tech, to generate striking animated GIFs.

Users also gain a step-by-step tool for moving, scaling and/or duplicating objects, along with the ability to tweak the position of people's faces to ensure they're "looking" in the right direction.

The app's Catalog tool – which includes albums, keyword tags, people, locations and more – is now automatically backed up too, ensuring none of your hard organisational work will go to waste.



**ALSO CONSIDER** Adobe Photoshop Elements & Premiere Elements bundle for £99.99 **SAVE 27%**

## Upgrade to Windows 11 Pro for just **£49.99**

[tinyurl.com/pcprowin11](https://tinyurl.com/pcprowin11)

If you're using Windows 11 Home but fancy switching to Professional, we have great news. Not only is it a steal at £49.99, but it's incredibly simple to do. Upgrading is a matter of typing "Change product key" and then entering your new Pro licence key into the dialog box. Windows will then update and reboot, and you'll see a fully activated Windows 11 Pro.

Within minutes, you'll have access to extra business functionality: enhanced BitLocker encryption, remote logins and more. Perhaps best of all, you can create and host virtual machines using Hyper-V, which is ideal for testing new software or, if you're a developer, checking how your software performs on other OSes.

Windows 11 Pro also enables you to quickly connect to a domain – this could be your business or a school – to access network files, servers and printers. It's ideal for taking your work on the road when you still need access to the office network.



**ALSO CONSIDER** Avast Ultimate 2023 (10/2yrs) for £29.99 **SAVE 85%**

## Acronis Cyber Protect Home Office 2023 Advanced for **£29.99** (1 device, 1 year, 50GB storage)

[tinyurl.com/pcprocyber](https://tinyurl.com/pcprocyber)

Acronis Cyber Protect has one simple aim: to protect your data from any threat. That means you get backup, disk cloning, cyber protection and privacy tools in a single package.

Advanced backup and disk cloning sit at this product's core. You get flexible backups, from full drive images to individual files, and clever incremental and differential options encourage daily backups without filling your storage. You also receive active disk cloning for migrating to faster or bigger hard drives. Perhaps most reassuringly, you benefit from Acronis' unique ransomware protection, too.

The Advanced version packs in a whole heap of extra features, including antivirus and anti-malware to protect your computer and your backups.

The £29.99 price, a 23% saving over the full £38.99 cost, includes a one-device licence for either a PC or Mac with a one-year subscription and 50GB of cloud storage.



**ALSO CONSIDER** Norton 360 Premium for £19.99 **SAVE 89%**

## Reskube Home Pro

The easy, one-box way to back up power and connectivity for home workers and small offices

SCORE ★★★★★

PRICE £999 (£1,199 inc VAT) from [reskube.com](http://reskube.com)

As remote working continues to boom, there's no shortage of solutions aiming to improve the resilience of your power or networking provision. However, Reskube's Home Pro is the first device we've come across that promises to do both: it's an uninterruptible power supply, offering up to 500W of backup power, and also provides fallback data connectivity through an integrated 4G LTE router. If the mains goes down, the Home Pro keeps its two forward sockets powered from the internal battery; if your internet connection is lost, it switches to the mobile data connection.

The design is basic but robust, with no controls aside from the power button. The front features two simple LED strips indicating battery life and current power output. At the back you'll find the mains power input plus an FM12315 port for solar power, again rated at 500W. The rear is also home to two Ethernet ports, which handle incoming WAN and outgoing LAN connections, plus SMA connectors for two mobile antennas and RP-SMA connectors for two Wi-Fi antennas. Above these, you'll find primary and secondary SIM trays.

Reskube claims the Home Pro is powerful enough to run a small office with five PCs or laptops, a switch and a printer. I'm not sure about that: it's certainly not sufficient for larger laser printers, which can draw around 1kW during their warm-up phase. However, it should be fine for a couple of home workers or a limited mobile retail setup. I tested the Home Pro under a constant 500W load and found the battery lasted for a decent 1hr 22mins before giving out. Over this time it supplied a total of 633Wh of power, about 82% of its stated 768Wh battery capacity, which is competitive for a compact battery power bank.



It's worth mentioning that, during the 500W load test, the Home Pro's cooling fans ran continually at top speed. The noise was audible, but not as loud as the warning buzzer, which sounds constantly when you exceed a load of 475W. At a 200W load the fans were quieter, and the battery delivered a total of 595Wh – roughly 77% of its claimed capacity.

The fans are distinctly audible when recharging, too. This happens at a fixed 500W rate, tailing off shortly before the batteries are fully charged. I measured a total power consumption of 801Wh for a complete recharge, so assuming the batteries went from fully discharged to fully recharged, that equates to an impressive 96% efficiency.

The Home Pro's power failover function works brilliantly. When I cut the incoming power, it switched to battery power in less than 10ms – much faster than most general-purpose battery backups, and certainly quick enough to avoid any glitching on my IT equipment.

Internally the Reskube Home Pro uses lithium-iron phosphate batteries, which have safer charging characteristics than standard lithium-ion chemistry. They also have a longer service life: Reskube says they'll maintain 100% capacity for 3,000 cycles, dropping to 60% after 5,000. That being the case, it's disappointing that the standard warranty is only 12 months, especially when other power supply manufacturers offer five years.

The Home Pro's networking capabilities are on the conservative side. The unit supports 4G at speeds up to 150Mbps/sec, carrier and signal strength permitting. For the best possible reception you can upgrade

Reskube's standard stubby antennas with cabled ones, but even then you shouldn't expect best-in-class network performance: the Home Pro's Wi-Fi network only supports 2.4GHz 802.11n Wi-Fi, and its Ethernet ports are limited to 100Mbps/sec.

Those limitations have a noticeable impact on network performance. My ISP line normally gives me download speeds of 100Mbps/sec, but that dropped to 62Mbps/sec over the Home Pro network. That's a shame, as for maximum resilience you'll want to keep your critical devices connected to the Home Pro. Still, there's enough bandwidth here to be productive, and the switchover to LTE is impressively smooth: I measured around nine seconds of downtime when switching from my fixed line to mobile data – fast enough that a YouTube video kept playing without interruption.

The Home Pro's web-based configuration interface is easy to use, and provides access to a huge range of configuration options. Oddly, though, you can't check the battery status, or change any power-related settings, such as selecting a slower charge rate or modifying the warning buzzer threshold. Reskube also offers a

ABOVE Reskube's Home Pro is robustly built and powered by an efficient battery



**"The power failover function works brilliantly. When I cut the incoming power, it switched to battery power in less than 10ms"**

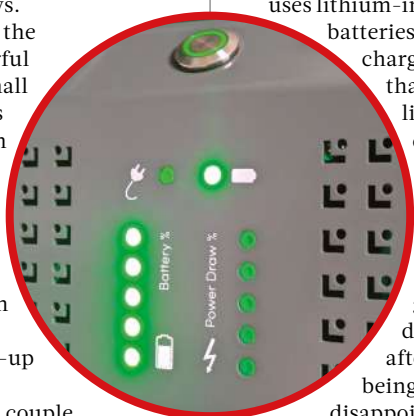
remote management option for £39 a year. This adds a command-line interface and full online access to the web dashboard, making it ideal for supporting remote users without needing to

go onsite or cause downtime.

The Reskube Home Pro is a simple concept, delivered well. It wouldn't hurt if it were quieter and had faster network support, but it offers the core protections you need in a single box that's easy to deploy and manage. It's also surprisingly good value, costing £999 exc VAT – only a little more than you'd pay for a similarly specified backup power supply and a dual-WAN router. Alternatively, the Reskube Home Pro can be leased for £444 per year. This means you don't have to worry about the stingy warranty, and it includes remote, telephone and online support. If you're looking to back up your key business systems, that seems like a price that's more than worth paying. **SIMON HANDBY**

### SPECIFICATIONS

500W UPS • 768Wh capacity • 4G (unlocked, up to 150Mbps/sec) • 2.4GHz 802.11n Wi-Fi • 2 x 1GbE ports (WAN, LAN) • 210 x 400 x 230mm (WDH) • 15kg • 1yr RTB warranty



LEFT Two simple LED strips on the front show battery life and current power output





## D-Link Eagle Pro AI R32

Simple, speedy over short distances and above all cheap, this Wi-Fi 6 router could be all you need

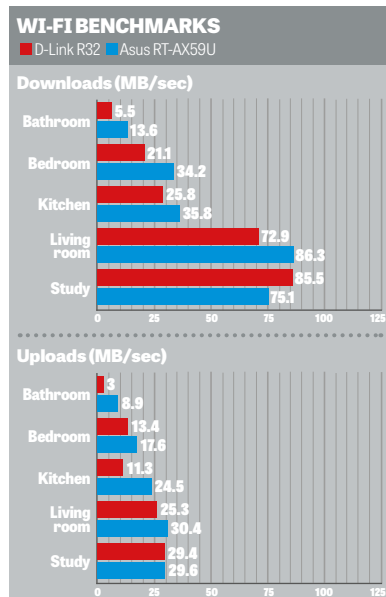
SCORE ★★★★★

PRICE £61 (£73 inc VAT) from amazon.co.uk

**A**I seems to be everywhere lately, and that includes the world of home networking: D-Link's latest "smart router" proudly wears its AI credentials on its sleeve. As we'll see, this is definitely a case where the buzzword oversells the reality, but if the R32 is short on smarts it makes up for that in value. As we went to press, it cost only £73 inc VAT on Amazon, making it one of the cheapest Wi-Fi 6 routers around.

The Eagle Pro AI R32 is the successor to last year's Eagle Pro AI R15, which was similarly cheap and looked almost identical. The main difference between the two is what you might guess from the name: the new model is just over twice as fast as the old one, in terms of wireless bandwidth. It supports connections of up to 800Mbps/sec on the 2.4GHz band, while the 5GHz radio goes up to a maximum speed of 2.4Gbps/sec. There's also more wired bandwidth available, as the R32 gains an extra Ethernet socket at the back, to make up a full quartet of gigabit LAN ports.

Aside from those sockets there's not much to see: no USB, no multi-gig connectors and only four LEDs on the front to show you the status of your power, internet and Wi-Fi. But that's fine – do you really need more?



Getting set up is delightfully simple, via either D-Link's Eagle Pro AI mobile app or the router's built-in web management interface. There isn't a huge amount to configure, but D-Link builds in more features than you might expect from such a cheap device. For example, a basic quality-of-service tool lets you assign different priority levels to individual clients, and you can also enforce internet access schedules and time limits for kids' devices.

For added security, you can flick a switch to replace your ISP's default DNS with secure DNS from Google or Cloudflare, offering protection from hijacking attacks. There's a basic configurable firewall, too, and an unexpected treat is an incoming VPN server, plus integrations with **no-ip.com** and **dyndns.com** to provide easy external access to your home network.

If you want to use the R32 as a Wi-Fi extender for an existing network you can alternatively switch it into bridge mode – or use mesh mode to connect two or more units together and spread your wireless signal over a wider area. Remember, though, that beaming mesh traffic back and forth between wireless stations eats into the bandwidth available for your devices, so you're trading off performance for range.

Finally, let's not forget the R32's promised "AI" capabilities. In practice, this simply means the router periodically checks its Wi-Fi channels and tunes its beamforming settings to get the best connection to your clients. These are welcome features, to be sure, but it's a pretty egregious overreach of the term AI.

Never mind; you're probably not buying a £73 router in the expectation of a world-class feature suite. The real question is, how does the thing perform? And the answer is very well – at close range. I tested the R32 by hooking up a NAS drive to one of its Ethernet ports, then hawking a laptop around my home

**ABOVE** The Eagle Pro AI R32 is a solid performer over short distances

and measuring upload and download speeds as I copied a set of 100MB test files to and from the NAS.

Initial findings were very positive. I was delighted to see an average download speed of 85.5MB/sec in the same room as the router, and when I moved downstairs to the living-room I still got a speedy 72.9MB/sec.

Unfortunately, the R32's four little antennas aren't beefy enough to keep up that sort of performance all through my home. Speeds fell to 25.8MB/sec in the kitchen and 21.1MB/sec in the bedroom; that's still ample bandwidth

for typical internet tasks – a 4K HDR video stream requires about 4MB/sec – but it's still a pretty precipitous drop.

Unsurprisingly, the R32 fared worst in the bathroom at the back of the house. Here I could clearly see my file transfers momentarily hang and resume several times during my tests, so while the eventual average download speed of 5.5MB/sec might sound fine for web browsing or cloud syncing, it's patchy: I'd rather not rely on it for video calls or online gaming.

Does this mean you should steer clear of the R32? It really depends on what you want from a router. Those who need reliable wide-area coverage should consider spending the extra £50 on the Asus RT-AX59U (see issue 350, p57): as well as more stable long-range coverage, it will give you a broader range of software features. However, if you just want basic connectivity across a few rooms, the R32 will fit the bill very nicely – there's no need to pay more. **DARIEN GRAHAM-SMITH**

### SPECIFICATIONS

Dual-band 2.4GHz/5GHz Wi-Fi 6 router • 2.4Gbps/sec on 5GHz radio, 800Mbps/sec on 2.4GHz radio • 4 x external antennas • 4 x gigabit Ethernet ports • 228 x 159 x 62mm (WDH, without antennas) • 2yr warranty



**ABOVE** Four LEDs on the front show power, internet and Wi-Fi statuses

## Onyx Boox Page

A lightweight, portable e-reader with remarkable battery life, but setup could be easier

SCORE ★★★★★

PRICE €233 (€280 inc VAT) from  
euroshop.boox.com

**W**ith a thick right-hand edge, the Onyx Boox Page looks much like the Kindle Oasis (see issue 281, p58) and the Kobo Libra 2 (see issue 329, p65). It shares the same superb 7in E Ink Carta 1200 screen as both models, but the Onyx Page is faster thanks to a better processor – and, despite being made of plastic, its body looks far more premium than the Libra, too. It also has a weight advantage at 310g rather than 390g, but the Oasis wins here at 188g.

Like its rivals, the physical page-turn buttons double up as volume controls. There's a speaker built-in for audiobook playback, but tinny sound quality means you'll soon be reaching for Bluetooth headphones.

Onyx provides a generous 32GB of storage, just like the Kobo Libra 2, but the Page also features a microSD slot – handy for audiobook fans. Moreover, the excellent 2,300mAh battery lasted for a whole month, averaging a couple of hours of use per day, before it dropped to 10%.

That's roughly 50% more than the Libra 2 with its 1,500mAh battery.

My main complaint is the dark overlay caused by Onyx's E Ink Center, which you use to access shortcuts or control sliders. I've seen this before on Onyx e-readers, but that's usually been a ghosting issue; here, the control panel's overlay remains on the page until a full page refresh occurs. To bypass this, I set the screen to refresh after every tap rather than the default five taps, but that did reduce battery life.

Another complaint I have is the lack of waterproofing for the Page, so avoid the bath, the pool and the kitchen sink when using this e-reader. Accessing content using the Onyx



**ABOVE** The Onyx Boox Page has a premium feel, despite the plastic finish

**"The excellent 2,300mAh battery lasted for a whole month, averaging a couple of hours of use per day, before it dropped to 10%"**

version of Android 11 and provides access to the Google Play Store. From here, you can download the Kindle and Kobo apps to find your next read.

If you don't mind being restricted to Android apps for Kindle or Kobo, the Onyx Boox Page can be considered

to be two e-readers in one.

However, both its main rivals are cheaper – the Oasis is £230, the Libra 2 £170 – and the latter remains our top pick.

**SHARMISHTA SARKAR**

### SPECIFICATIONS

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# LINUX DISTROS

**Whether you want to give an old Windows PC new life or simply get to grips with Linux, one of these eight distros will be the perfect choice**

**L**et's address the penguin in the room before we go any further. In the 30-plus years since it first appeared, Linux has captured a fraction over 3% of the desktop. For every Linux machine in home or office use, there are 20-plus running Windows and six running macOS. So it's a failure, right?

Absolutely not. There's a reason why Linux supports a growing number of companies whose existence is based on the open-source model. Together, they employ a workforce of millions. Pick away at the internet and Linux is almost everywhere.

Reverse-engineer the OS of most smartphones and you'll uncover the Linux kernel – eventually. And with single-board computers such as Raspberry Pi increasingly evident in STEM environments, a higher proportion of tomorrow's workforce will be comfortable with Linux than ever before.

So, rather than being a relic or a failure, Linux is thriving. Its future looks bright, and familiarity with its conventions can pay dividends in a business context, where what's learned on the desktop can often be applied on a server or in Windows Subsystem for Linux. At home, knowledge of

Linux commands can likewise help when diagnosing problems with a web-hosting package, or when installing a broader range of applications than WordPress and MediaWiki.

And that's ignoring the fact that Linux remains a viable route to extending the life of a tired, outdated computer. Especially one that's running Windows 10 or earlier.

**DistroWatch.com**, which tracks Linux releases and related news, currently lists 958 distributions. We've carefully chosen eight of those for our Labs. Most of their names, like Fedora and Ubuntu, should be

familiar, but we've included two – Nitrox and Rocky – that offer something genuinely different, or plug an evident gap.

Nor do you need to be an expert to install these distros. We provide a step-by-step guide on the process on p82, and explain the basics of what we mean by the desktop environment on p85. Nor do you have to commit to running Linux, as all of our test OSES can be run from a thumb drive first. Who knows, you may even be inspired to make Linux your daily working environment.

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**CONTRIBUTOR:** Nik Rawlinson 



# Linux basics: what you need to know

While Linux distributions tend to be free (like all the ones on test here), this is our equivalent of a buyer's guide – after all, your choice will consume the commodity of time

**T**here's nothing stopping you trying Linux today. Most distributions are free to download, and although we installed each on bare metal for our tests, they generally run as well in a virtualised environment or from a thumb drive as they do from an SSD. So, if you want to try before you buy, there's no need to sacrifice your boot drive until you're sure that Linux does what you need.

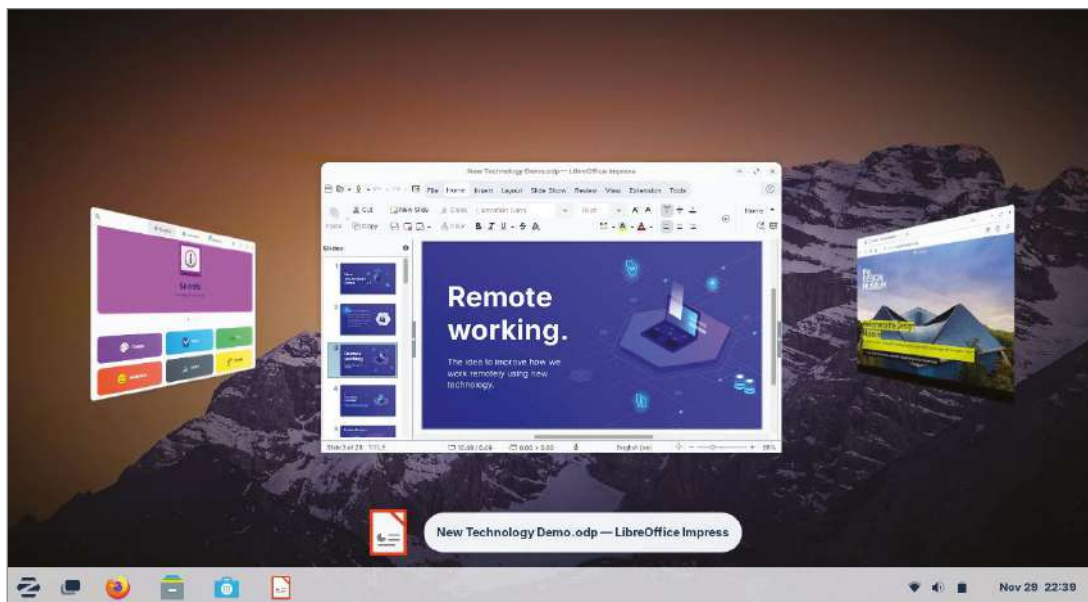
Distributions can be separated into families. Of these, the Debian family, which includes Ubuntu, Zorin and Raspberry Pi OS, is the largest – but that doesn't necessarily mean it should be your go-to. Fedora emerged from the code behind Red Hat Linux, and Red Hat Enterprise Linux in turn draws code from the Fedora project.

Does the family matter? Unless you spend a lot of time typing commands through the console, where conventions differ between distributions, it doesn't really matter which family you choose. However, if you use Red Hat Enterprise Linux at work, even only in passing, it probably makes sense to opt for Fedora at home. If your work has picked Ubuntu, then that or another Debian-based distro makes sense at home.

## ■ Kernels

It's a similar story where the kernel is concerned. Think of this as the core of Linux, the link between the hardware and the processes that run above it (such as the desktop environment). The kernel varies between distributions, and is determined by the production team's development cycle and policies. However, what may appear to be an outdated kernel isn't necessarily cause for concern. Rocky Linux, for example, still uses the 5.14 kernel when the latest release is 6.6.4, but Rocky is based on Red Hat, where accommodations are made to implement any necessary updates without switching out the kernel until the next full-point release.

The Linux kernel underpins a broad sweep of operating systems, including Android – the world's most populous OS – and here, the specific build differs between handsets. What constitutes the best choice of kernel for one device



**ABOVE** If you use a particular family of distro at work, it makes sense to opt for it at home too

**If you already use Linux at work or home, and want to do the same in the other, it's worth picking the same environment**

doesn't necessarily apply to all the others, and it's worth bearing this in mind when considering the desktop, too. Concern yourself more with the security of your operating system and the developer's ability to deliver timely updates and patches, and less with the code at its core, of which you'll be largely ignorant in daily use.

## ■ Desktop environment

A more obvious differentiator, and the one that will have the

greatest impact in your daily use, is the desktop environment. While macOS and Windows each have only one native desktop environment, Linux distributions are frequently available with one default or preferred environment, and a selection of

alternatives. The openSUSE installer, for example, may put KDE at the top of a list of options, but as that list also contains Gnome and Xfce, it's up to you which you choose, and whatever you end up with will have no bearing on the underlying operating system.

The way these work can vary significantly, and switching from one to another can be as confusing as migrating from Android to iOS and vice versa. If you already use Linux at work or home, and want to do the same in the other, it's worth picking the same environment, even if the underlying operating systems are mismatched. We go into more detail about desktop environments on p85.

## ■ Support


Finally, consider support. How often is the OS updated, how long will your chosen build continue to receive patches, and is it easy to upgrade to the next edition when it reaches end of life? Does it have an active user base to which you can reach out with problems, and are answers readily available online?

In a business context, perhaps the most important question is the availability of service contracts, whether through the developer itself or a third party. If not, running your business on "free" software might actually end up costing you more than using a paid-for alternative.

## How we test

We install each distribution onto a mini PC with 8GB of memory, built around an AMD Ryzen 5 3500U processor, rather than a virtual machine. That helps us to accurately gauge how easy they are to set up, and how well they run in general use. We also run performance tests on each one (see the results on p93), although the results were so close we did not consider this a factor in our final judgement.

Naturally, we also put each distro through usability tests, including writing every word written in this Labs.

								
	RECOMMENDED	RECOMMENDED	RECOMMENDED	Nitrux OS	RECOMMENDED	Rocky Linux	LABS WINNER	RECOMMENDED
	Debian with Raspberry Pi Desktop	Fedora Linux	Linux Mint		opensUSE Tumbleweed		Ubuntu Desktop	Zorin OS
Overall rating	★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
URL	raspberrypi.com/software	fedoraproject.org	linuxmint.com	nxos.org	get.opensuse.org/tumbleweed	rockylinux.org	ubuntu.com	zorin.com
Current version	N/A	39	21.2	3.2.0	N/A	9.3	23.10	17
Release date	1 July 2022	7 November 2023	27 September 2023	27 November 2023	On day of download	20 November 2023	16 October 2023	20 December 2023
Release model	Periodic	Periodic	Periodic	Periodic	Rolling	Periodic	Periodic	Periodic
End of support	N/A	Rolling	2027	Not stated	Rolling	31 May 2032	July 2024	Two years on average
Technical details								
Family	Debian	Red Hat	Debian	Debian	SUSE	Red Hat	Debian	Debian
Architecture	x86-64	x86-64, ARM, PowerPC, IBM Z, MIPS, RISC	x86-64	x86-64	x86-64, i686, ARM, IBM Z, PowerPC	x86-64, ARM, ppc64le, s390x	x86-64, ARM, RISC, ppc64le	x86-64
Editions	Desktop	Workstation, Server, IoT	Desktop	Desktop	Desktop, Server	Desktop	Desktop, Server, IoT	Desktop
Linux kernel	5.10	6.5	5.15	6.6	6.6	5.14	6.5	6.2
Download size	3.4GB	2GB (also available via media writer)	2.8GB	3.4GB	4.3GB	9.8GB	3.4GB	3.4GB
Installer	Via live session	Anaconda graphical installer	Via live session	Calamares graphical installer	Via live session	Via live session	Via live session	Via live session
Desktops	PIXEL	Gnome, KDE Plasma, Xfce, LXQt, LXDE, Mate, Cinnamon, Budgie, Sway, Phosh, SOAS, i3	Cinnamon, Mate, Xfce	NX Desktop on KDE Plasma 5	Gnome, Xfce, Cinnamon, Mate, KDE Plasma 5	Gnome, KDE, Xfce, Mate, Cinnamon	Gnome (other desktops available from allied projects)	Gnome (customised), Xfce (customised)
Geekbench results								
Single core	N/A	1,105	1,133	1,059	1,167	1,097	1,128	1,109
Multicore	N/A	3,053	3,129	3,081	3,241	3,112	3,184	3,194
Requirements								
CPU	1GHz <sup>1</sup>	2GHz	Not stated	2.5GHz dual core (2.4GHz quad-core recommended)	2GHz	Not stated	2GHz dual-core	1GHz dual-core
Memory	2GB <sup>1</sup>	4GB	2GB (4GB recommended)	4GB (8GB recommended)	2GB	1.5GB for x86-64 PCs <sup>2</sup>	4GB	1.5GB
Storage	10GB <sup>1</sup>	40GB	20GB (100GB recommended)	14.17GB	40GB	Not stated	25GB	15GB

<sup>1</sup>System requirements as per upstream codebase, Debian 11. <sup>2</sup>System requirements as per upstream codebase, Red Hat Enterprise Linux 9.



# How to install Linux

Completely new to Linux distros? Fear not, as we provide a step-by-step guide to take you from initial download to installing applications

**M**ost Linux distributions are free to download and install. All you need to get started is an ISO and a thumb drive to host the installer. While we prefer to run Linux on a dedicated hard drive or SSD, we've yet to come across an installer that won't offer to repartition an existing internal drive. Do that and you can run Linux alongside an existing Windows installation.

## STEP 1 DOWNLOAD BALENAETCHER

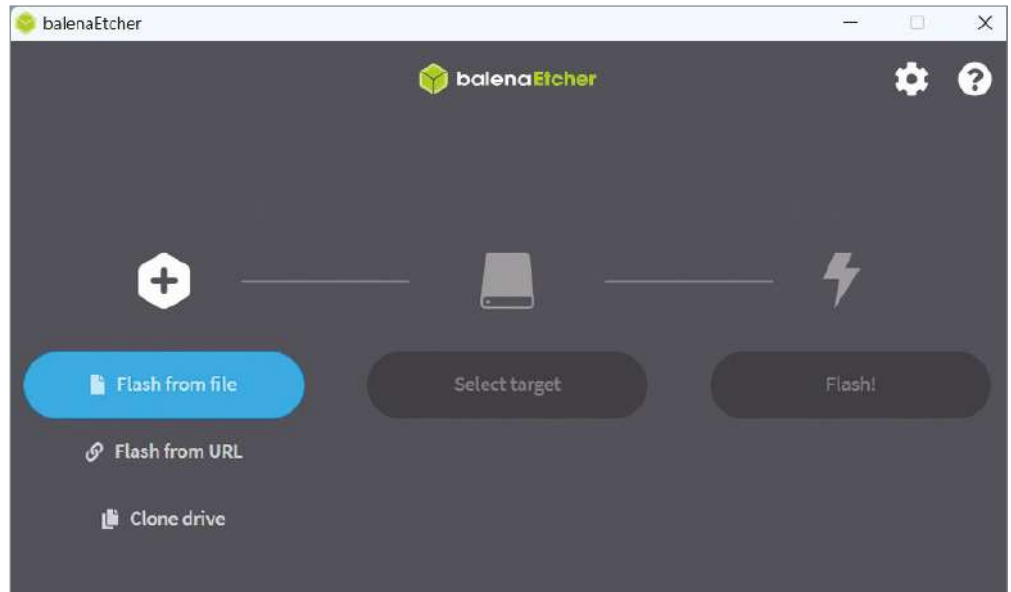
BalenaEtcher extracts ISOs onto USB drives and sets them up for booting. All of the distributions on test, unless they had a media creator, were installed in this manner, either from the live OS or a specific installation routine that appears at boot. BalenaEtcher is a free download from [etcher.balena.io](https://etcher.balena.io). When it's finished downloading, install and launch it.

## STEP 2 DOWNLOAD LINUX

Once you've decided which version of Linux you want to install, download an ISO of its desktop, workstation or client version. Frequently, each will be available for a variety of processor architectures, so make sure you choose the appropriate distribution for your PC, which will almost certainly be marked as x86\_64, x86-64 or AMD64.

## STEP 3 SELECT THE DISTRO AND DRIVE

Plug in your USB thumb drive and, once it's mounted, switch to



**ABOVE** BalenaEtcher extracts ISOs onto USB drives

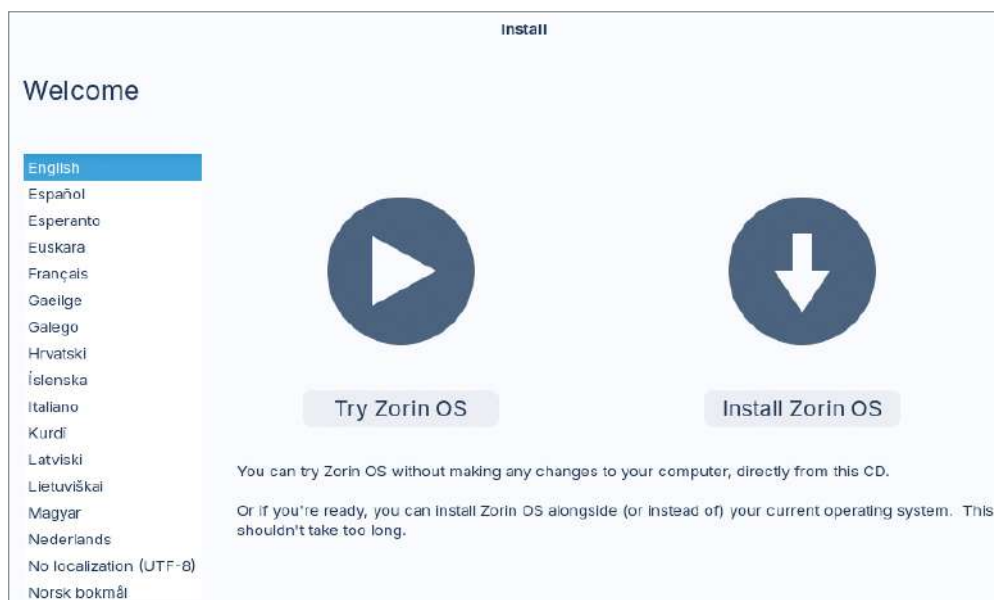
balenaEtcher. Click "Flash from file" and select the ISO you downloaded in the previous step. Next, click "Select target" and choose your USB thumb drive. Note that it's possible to select

**We've yet to come across an installer that won't offer to repartition an existing drive. Do that and you can run Linux alongside Windows**

multiple drives simultaneously, so make sure you've chosen the right one, then click "Select 1". Check that the correct ISO and drive are shown on the balenaEtcher

home screen, then click Flash. Windows will pop up a User Account Control dialog asking whether you want to authorise it to make changes. Allow this, and the process will begin.

**BELOW** Most distros give you the option of trying the OS first



## STEP 4 CONFIGURE YOUR BIOS

Extracting the ISO and writing it to your USB flash drive should take less than five minutes. Once the process has completed, eject the drive and plug it in to the machine on which you want to install Linux. Start or reboot it, then press the button that either directs it to start from an external drive or opens the BIOS or UEFI. This is usually shown briefly during the boot process. If it isn't, common options are F10, F11 or F12. Search online for your specific motherboard or computer manufacturer.

## STEP 5 SET YOUR STARTUP DRIVE

When you've entered the BIOS or UEFI configurator, navigate through its screens, which vary depending on manufacturer, until you find an option for setting your boot device. Give priority to your USB-mounted flash drive, save any changes you have made, then exit. Your PC will reboot again.

What happens next depends on the build of Linux you're installing. Some will launch a dedicated installer immediately, but many will initiate a live environment in which you can use most of the operating system's features directly. This may be overlaid by a dialog offering to install the OS directly, or there may be a shortcut to this on the desktop. In either case, initiate the process.

**RIGHT** You'll usually be asked whether you want to download third-party add-ons

## STEP 6 INSTALL LINUX

The first few screens of the installation process will usually ask you to specify your installation language and keyboard layout. You'll also be asked to set up your network connection. Although you can often skip the network step, we'd recommend following through as it will allow the installer to check whether it has been updated itself – and to download additional components and options.

One example is third-party codecs, which might not be included in the original bundle because they don't have an open-source licence. You'll usually be asked whether you want to download these add-ons. We normally opt to do so but, depending on how you feel about closed- versus open-source code, you'll need to make your own decision.

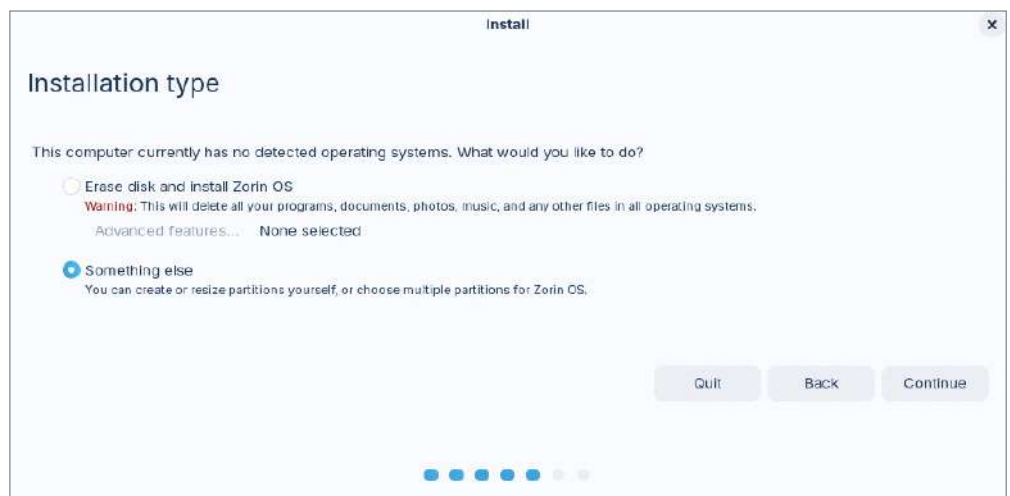
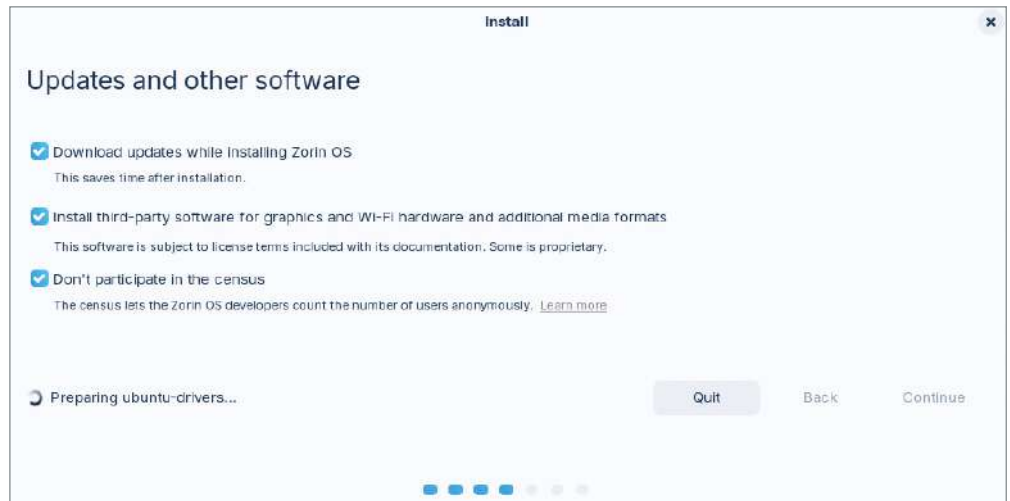
## STEP 7 PARTITION YOUR DRIVE

You now need to decide whether you want to install Linux alongside an existing operating system, if your machine already has one, or wipe the drive and install it solo. Here, we're installing Zorin on a virtual machine with an empty drive, but we can still manually choose how we want to partition the drive by clicking "Something else", then Continue.

If you choose to install two operating systems side by side then, whichever version of Linux you want to set up, make sure you have an up-to-date backup of the original OS from which you can restore should something go wrong when repartitioning the drive.

## STEP 8 GO FOR IT

There are plenty of opportunities to back out along the way but, if you're happy with the decisions you've made, the final step is to commit to the process and install Linux on your machine. The length of time this takes



**ABOVE** You can choose how you want to partition the drive

can vary significantly, based on the speed of your PC, the speed of your thumb drive, the size and complexity of the distribution you're installing, and whether it needs to download any additional resources.

When the process has finished, reboot your PC and, unless prompted to do so earlier, remove the USB flash drive immediately after restart so it's not used as your boot source.

## STEP 9 APPLY UPDATES

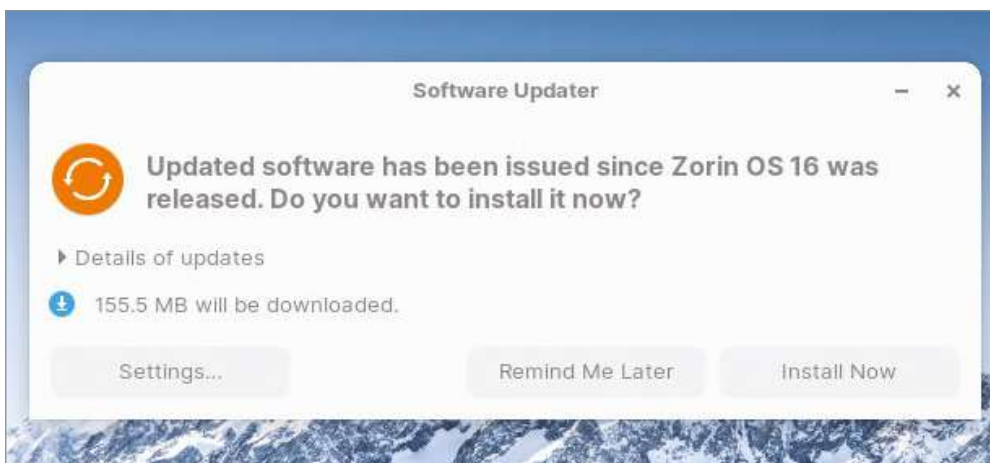
Like Windows, Linux receives regular patches, and there's a fair chance that

unless the ISO you downloaded was freshly compiled (as would be the case with a rolling system such as openSUSE) there will already be patches or updates available.

Your first job on booting the new operating system, therefore, is to connect to your network and allow it to check for patches. Most will check automatically but, if not, check for a dedicated software installer, such as the App Center or Software utilities (depending on the version) in Ubuntu.

## STEP 10 INSTALL APPLICATIONS

Most distributions install a range of default applications, usually covering productivity, browsing and communications. Depending on how you plan to use your computer, these might not cover all bases, so you should browse the integrated app installer for any additional tools you require. Note that the range of applications will vary between distributions depending on which repositories they can access. Check the documentation if you want to add extra repositories, or download applications directly from developer sites if they aren't included.







# Debian with Raspberry Pi Desktop

This is a responsive distro that new switchers may struggle with, but purists will find much to admire

SCORE ★★★★★

WEBSITE [raspberrypi.com/software](https://raspberrypi.com/software)



**M**any distributions are available in full-fat and light editions. Zorin and Linux Mint are good examples, each giving a choice of Gnome- or Xfce-based ISOs. Debian with Raspberry Desktop, which closely resembles Raspberry Pi OS, is different. Available for PCs after a decade as the default OS for the eponymous single-board computer, it uses neither Gnome nor Xfce, but PIXEL, the Pi Improved Xwindows Environment, Lightweight, which itself is based on the lightweight LXDE desktop manager.

Don't let the "lightweight" moniker put you off. PIXEL sports many features familiar from rival environments, including a menu bar, application menu, desktop icons and context menus. It does lack some frills, though. There are no widgets, as there are in Mint, you can't snap windows to the edges of the screen for easy arrangement, and it lacks Zorin's visual flair.

However, it does boot extremely quickly, it has every feature you're likely to need, and its options and settings are as easy to find as they are to understand.

The operating system's original name – Raspbian – hint at its Debian roots. In fact, you could be forgiven for thinking you were installing stock Debian when working your way through the installer, as there's no mention of Raspberry Pi to be found.

It's built on Bullseye (Debian 11) and the Linux 5.10 kernel, both of which are starting to show their age. Debian is currently at 12.2 (Bookworm), on which the regular Raspberry Pi OS for single-board computers is based, and it supports the 6.1 kernel.

Where Raspberry Pi has produced its own imager for setting up Raspberry Pi OS, which also handles user creation, configuring SSH,

establishing Wi-Fi credentials and so on, the process for installing Debian with Raspberry Pi Desktop is much like that for most other distributions. Download the ISO, write it to a bootable USB drive, and boot the installer from there. Around ten minutes later, we were sitting in front of the desktop, with a full complement of essential applications ready to be used.

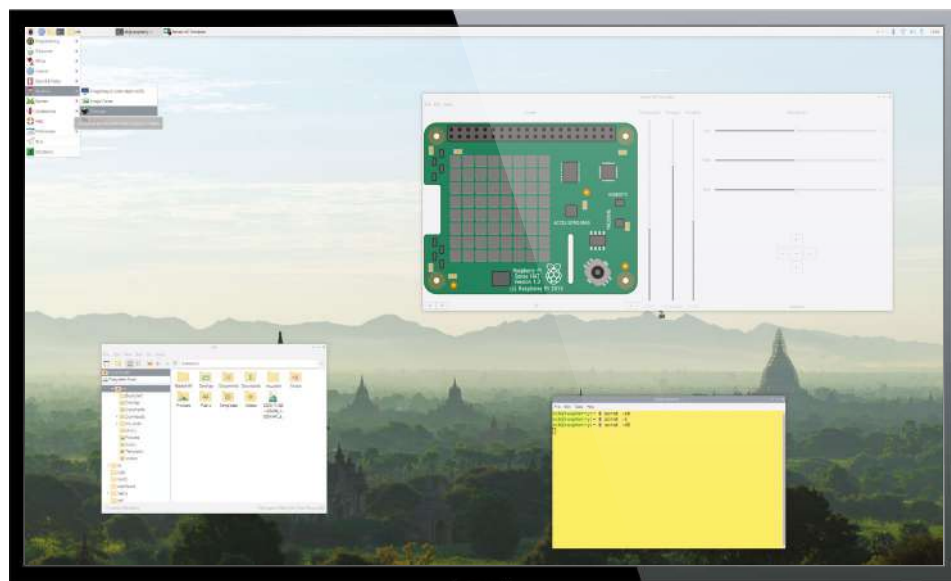
The pre-installed office suite is LibreOffice 7.0.4 (the latest is 7.6), Claws is installed to manage mail, and the default web browser is Chromium. Other applications can be installed via the Add/Remove Software tool, or using APT through the Terminal. We opted for the latter to install Firefox and Thunderbird, and in each case it set up version 115. This is particularly welcome where Thunderbird is concerned, as 115 marked a significant interface refresh, which makes the suite a more pleasant environment in which to spend the working day.

Elsewhere, the list of pre-installed apps is a reminder that Raspberry Pi is popular in STEM environments, coding and automation. Both Geany Programmer's Editor and the excellent Thonny IDE are in evidence,

**ABOVE** Debian comes with a full complement of essential apps

**The list of pre-installed apps is a reminder that Raspberry Pi is popular in STEM environments, coding and automation**

**BELOW** The Add/Remove Software tool isn't as friendly as some others



alongside Scratch and Mu. So is the SmartSim circuit designer.

VLC and an image viewer are both pre-installed, but GIMP (for bitmap graphics), Inkscape (vectors) and Shotwell (photos) all need to be installed manually – if you use them. Again, this can be done through the Add/Remove Software utility, but this isn't as friendly as the equivalent installers in Ubuntu, Mint and co,

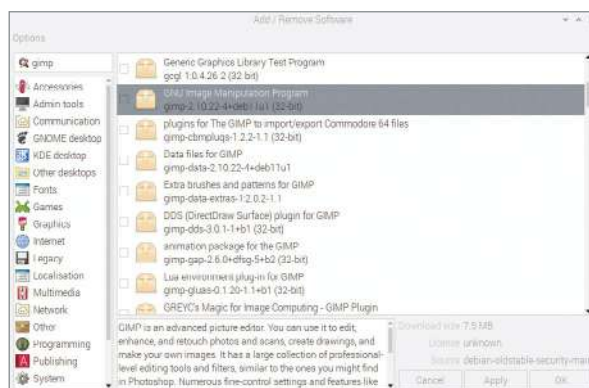
presenting sometimes extensive lists of options in response to a search, each accompanied by the same default icon. You might occasionally find yourself scratching your head, wondering

which you need.

PIXEL includes a Recommended Software tool, which does allow you to sidestep both the software installer and APT for a handful of common applications, but the three mentioned in the previous paragraph are absent. We'd like to see them included in the next refresh.

While we've griped about a few aspects of Debian with Raspberry Pi Desktop, there's much to recommend it. It's extremely fast to boot, the PIXEL interface is refreshingly distraction-free, and it's compact enough to be a reasonable option for running full-time from a USB thumb drive.

Yes, it's starting to look outdated in places (note that it was released in July 2022), but Raspberry Pi tells us an update is planned, which is expected, although not guaranteed, to arrive before Easter. In the meantime, if you're looking to recycle some older hardware as a no-frills workhorse, or want to use the same environment on your single-board computer and desktop, this distro could be just what you're after.



# What is a desktop environment?

Unlike Windows, Linux distros often offer a choice of desktop environments. Here, we explain the difference between them and how to decide which best suits your needs

**A** Linux distribution is made up of hundreds of components. Some of these are core, such as the kernel and package manager. Of those, the kernel is the nugget of code that manages transactions between the operating system and your hardware, while the package manager is used to install, upgrade and remove software, plus configuration files, extensions and other executable data.

Although the range of package managers available to you will vary depending on the version of Linux you install, it needn't be a primary consideration when choosing. There is some variation in the commands you'll need to use to wrangle each package manager via the keyboard, but most can be controlled at arm's length using the software store built into your distribution. You'll also be very unlucky – and unlikely – to find that a particular mainstream package is unavailable through the manager tied to your distribution.

## ■ Switching environments

The desktop environment will have a greater impact on your day-to-day working than the kernel or package manager. However, although it's an important part of your Linux OS, the desktop environment is rarely integral. That is, although you can't use the GUI without one, few distros are only compatible with a single environment the way Windows, macOS or iOS are. So, how do they differ?

KDE and Cinnamon both have many features that will be familiar to Windows users. In particular, each has an equivalent of the taskbar, and an application menu similar to Windows' Start menu. For less confident switchers, choosing a distribution in which either is the default environment can make a lot of sense. For example, you might pick Linux Mint, which runs Cinnamon, or openSUSE, which puts KDE at the top of the installer's list of options.

The other big-name desktop is Gnome, which may require a little rethinking from Windows switchers. There's no taskbar and, by default, you can't save files on the desktop (not that you should). In many cases, the application launcher is hidden; Ubuntu keeps it on display on the



**ABOVE** Linux Mint (left) runs Cinnamon, while Fedora (right) runs Gnome

left-hand edge of the screen. Many of these changes were implemented in the move from Gnome 2.x to Gnome 3, and it was the decision to drop support for the taskbar and widgets that inspired the creation of Cinnamon.

## ■ Customised environments

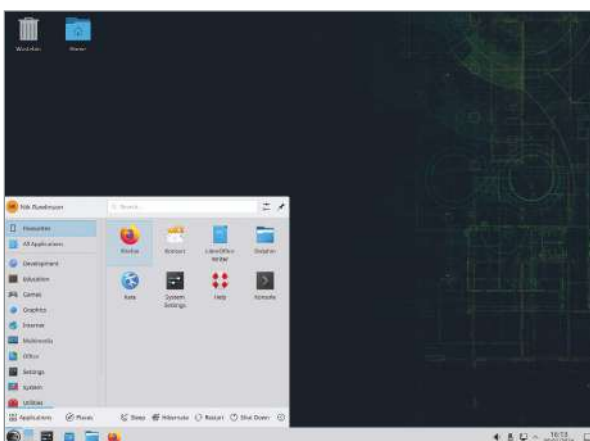
By tweaking their default styles and behaviour, developers can create their own unique take on a desktop environment as a way to separate their distribution from rivals.

Zorin is one distro that has done this very

successfully. Its non-Lite builds incorporate Gnome, although you would be hard-pressed to tell just by looking, as it's been highly customised to introduce conventions, such as the Windows-style menu and taskbar, that are otherwise missing in Gnome.

**Gnome may require a little rethinking from Windows switchers. There's no taskbar and, by default, you can't save files on the desktop**

**BELOW** openSUSE has an app menu similar to Windows' Start menu



This can be switched for a dock-based interface, similar to macOS and, as an inducement to upgrade to a charged-for release, the Pro build includes yet further variations. Similarly, Nitrux runs KDE Plasma, just like openSUSE, although with significant retheming to produce an attractive departure from the norm.

## ■ Lightweight desktop environments

Gnome, KDE and Cinnamon are best suited to use on mainstream hardware. If you're running an older, less powerful computer or a single-board computer such as a Raspberry Pi, you may be better served by a slimmed-down desktop environment developed specifically with your configuration in mind.

Mate and LXQt are two popular options, which are frequently offered as alternatives by a wide range of mainstream Linux distributions.

Raspberry Pi has also developed its own environment called PIXEL (Pi Improved Xwindows Environment, Lightweight), based on LXDE (Lightweight X11 Desktop Environment). Again, it includes a taskbar equivalent (by default at the top of the screen, although you can move it), and files can appear on the desktop, which isn't possible in a default Gnome installation. This is ideal for use on Raspberry Pi's single-board computers, and its appearance in Debian with Raspberry Pi Desktop makes that an appealing choice for more conservative PCs.





## Fedora Linux 39

The runner-up in this Labs, Fedora is regularly updated, easy on the eye and lightweight in its demands

SCORE ★★★★★

WEBSITE [fedoraproject.org](https://fedoraproject.org)



**F**edora Linux is refreshed every six months, with version 39 shipping in November 2023, 20 years (and one day) since the first iteration's debut. It was originally a spin-off of Red Hat Linux, but the tables have been turned and it now forms the basis of Red Hat Enterprise Linux and CentOS Stream.

Of the five versions on offer, we reviewed the desktop build, which sits alongside server, cloud, containerised and IoT editions. Each release receives support for 13 months, with version 40 scheduled to appear in April 2024, and build 39 reaching end of life in November 2024.

Fedora has a free-to-download media creation tool, much like Microsoft's equivalent for Windows, and the Raspberry Pi imager for the single-board computers. This writes the latest build to a bootable thumb drive. Use this to start up, and you'll encounter one of the best installers we've come across. It's simple, straightforward and painless.

System requirements are 4GB of memory and a 40GB SSD, although Fedora Project notes that it's possible to run the OS on less than this.

Our installation featured a slim selection of pre-installed applications, including Firefox 119, Rhythmbox Music Player, Boxes virtual machine environment and the latest edition of LibreOffice – release 7.6. However, we needed to install our own email client, as well as common creativity tools such as GIMP and Inkscape. You can do this through the integrated software tool, where we found 61 updates waiting to be processed on first launch. This isn't as drastic as it sounds, as many of them were fonts and codecs.

The Flatpak package manager is enabled and, if you prefer to update manually, Fedora uses the DNF package manager for RPM.

Where some distributions are just now managing the transition from

the X11 display server technology to Wayland, Fedora began that process several releases back, and release 39 marks the 14th edition since it completed the transition. Wayland's frequently touted benefits, not just by Fedora but in general, include greater security and better performance.

The default desktop environment is Gnome 45, which isn't a huge step up from 44. There are some welcome touches, though, such as subtly redesigned window elements, where two-tone colourways and full-height sidebars tidy things up. There's also an improved workspace indicator in the top left corner. Click it once and you get an overview of your open windows, some of which might otherwise be hidden, alongside a quick way to switch between desktops. It's useful, but you can achieve the same result by pressing the Super key.

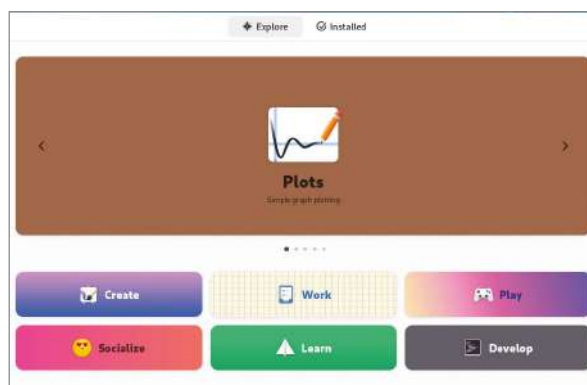
There's also a new Image Viewer, which Fedora notes has also been rewritten for high performance, while Gnome search has also been reworked with a focus on speed. The improvements don't only apply in the Files app, but across several core Gnome tools, such as Software and Characters.

**ABOVE** The default menu is well designed and attractive



**With one of the best thought-out installers and a wide choice of desktop environments, there's much to like about Fedora**

**BELOW** The selection of pre-installed apps includes the latest edition of LibreOffice



If you don't get on with Gnome, there are several alternative builds – Spins in Fedora parlance – running the lightweight XFCE desktop, KDE Plasma or Cinnamon, among others. Cinnamon, as used by Linux Mint, is often touted by advocates of Windows-to-Linux switching as a reason to choose that distro.

There's also a handful of immutable deployments, which keep OS code and apps separate, as with Nitrix. By making the core of the OS read-only, it can't be hijacked by malicious

actors or corrupted by a bad or incomplete update. The result is a more secure environment, for use in sensitive workplaces such as finance and government.

Fedora scored 1,105 in our Geekbench single-core test and 3,053 in the multicore section. These figures were broadly similar to what we saw in the Red Hat Enterprise Linux-based Rocky Linux, which, while slightly lagging in the single-core tests, was around 1.8% faster on the multicore tests. In neither case should it make any noticeable difference in day-to-day use.

With one of the best thought-out installers and a wide choice of desktop environments, there's much to like about Fedora, which is why it's our runner-up to Ubuntu. The default installation was minimal, but many will appreciate this, and all the tools you could possibly need are waiting in the software manager.

That Fedora is a primary source for Red Hat Enterprise Linux should fill you with confidence, and the fact it's available with a variety of desktops will make it immediately familiar, whether switching from Windows or a Debian-based rival.

## Linux Mint 21.2

A solid choice for anyone switching from Windows due to its familiar desktop environment

SCORE ★★★★★

WEBSITE [linuxmint.com](https://linuxmint.com)



**M**any Debian-based distros, Linux Mint included, use Ubuntu as their jumping-off point. The latest release – 21.2 Victoria – is based on Ubuntu 22.04 LTS and will continue to be supported until 2027. That means it currently uses the 5.15 LTS kernel, but there's a bleeding-edge edition, aptly called 21.2 Cinnamon Edge, that uses 6.2 should you prefer.

Where many Ubuntu spin-offs stick with Gnome display manager, as used by Ubuntu itself, Mint's default is Cinnamon. This started as an offshoot from Gnome 2 when version 3 was released. Version 3 was the first to drop support for the panel (taskbar in Windows parlance) in favour of a purer shell, which likewise demoted widgets and jettisoned desktop icons. Cinnamon puts all of these front and centre, which is one of the reasons it's often held up as an ideal distro for anyone switching from Windows. It also has a Windows-like menu, with applications sorted into categories, and essential tools – such as the browser and settings – kept in view up the side. You can pin your most used apps to the panel so they're never more than a click away.

Cinnamon is certainly a sturdy, tidy interface, but we think it feels a touch old-fashioned when compared directly with Microsoft's Fluent UI for Windows 11. If it doesn't immediately grab you, you can tweak the colours, install a theme, or opt for one of the alternative desktop managers, since Mint is also available with Mate or Xfce. And, while it seems highly unlikely that Ubuntu is going to disappear any time soon, the Mint developers are maintaining a parallel build, LMDE – Linux Mint Debian Edition – based on the Debian codebase, from which development can continue.

Whichever build you choose, you'll need at least 2GB of memory and 20GB of storage, although 4GB and 100GB

are recommended. These are hardly onerous, and the same specs apply to the Cinnamon Edge release.

Getting up and running is a familiar process, which starts with booting into a live installer and stepping through the wizard. However, because of changes to Ubuntu's shim-signed bootloader, compatibility with Secure Boot was broken for the ISO that was current when we performed our tests. We therefore had to disable Secure Boot to proceed and, unless the ISO has been fixed by the time you install, you may have to do the same. Linux Mint says that it's working on a fix.

Once up and running, pretty much everything was ready for use. Our monitor was recognised and its native resolution selected, our two network printers were installed, and a range of default applications were in place. Three desklets – effectively Windows-style widgets – for a clock, launcher

**ABOVE** The menu will be familiar to anyone used to Windows

and digital photo frame are installed but not activated. You can add others from a desklet store, where we'd highly recommend the weather desklet and notepad.

LibreOffice was ready to roll, and while we can't say the same for GIMP and VNC, they were available through the software manager, which

**Hypnotix, Linux Mint's IPTV application, is perhaps the most impressive default app. It links to more than 1,200 broadcasters**

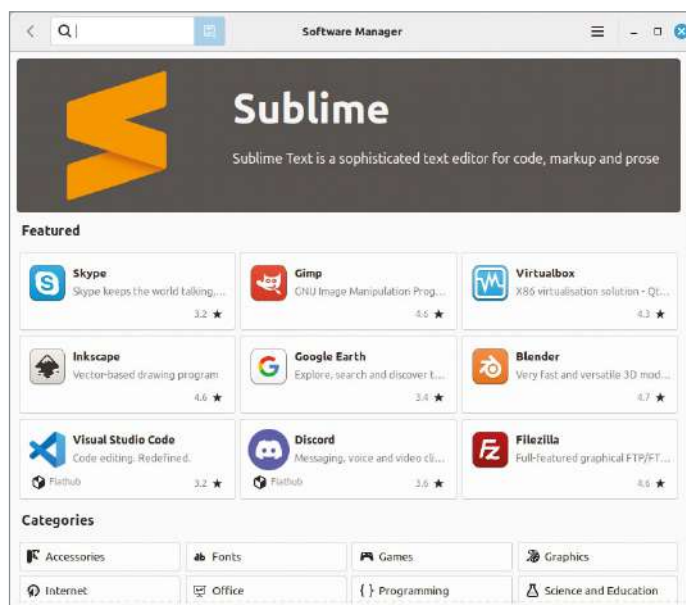
was set up to work with Flatpak. Thunderbird was pre-installed for handling mail, and Firefox was set up as the default browser.

Hypnotix, Linux Mint's bespoke IPTV application, is perhaps the most

impressive of all the default apps. Its integrated catalogue includes links to more than 1,200 broadcasters, organised by country, with 92 from the UK. Pick a country, then click a channel in the sidebar to tune in. It was quick, efficient and very smooth on our consumer broadband

connection. At the time of testing, it wasn't possible to save favourites, but that may change as work is ongoing for a future release.

Linux Mint with Cinnamon is a pleasant place to spend a lot of time, and while we don't think Cinnamon feels as dynamic as Windows 11, its familiarity will likely be a significant draw for more cautious switchers (although we would urge anyone in that position to also consider "new kid on the block" Zorin). Hypnotix and the desklets are the star turns in this distribution, and they're reason enough on their own to make it one for the shortlist.







# Nitrox OS

The security-focused Nitrox should give rivals food for thought, but it takes some getting used to

SCORE ★★★★★

WEBSITE [nxos.org](https://nxos.org)



**O**n first encounter, Nitrox 3.2 is a moody beast. The default UI is dark, file management windows have black backgrounds and apps are dimmed when they lose focus. Yet somehow, even if you're not a fan of dark modes (as this writer isn't), it works.

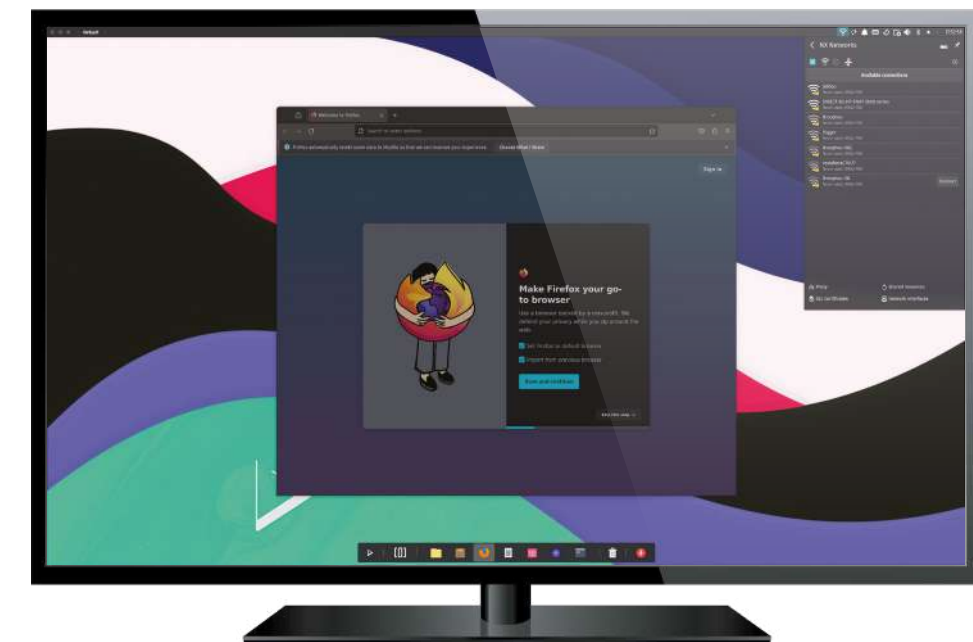
You can switch between windows for some real showmanship: apps swoop around each other to make space, and where two windows sit side by side, they part to let hidden windows through. The default font is skinny but easy on the eye, and while the launcher is too angular for our tastes, that's a matter of personal preference.

Where we think it's less successful is in detaching the windows buttons – close, maximise and minimise – and putting them up in the screen's top left corner, where they sit on the end of the menu bar. This is, presumably, why apps without focus are dimmed: so you know which one you're going to close or enlarge when you click them. A side effect is that when switching between a browser and word processor, if you're referring to the former while writing in the latter, your reference material will frequently change brightness.

Elsewhere, the file manager (called Index) has a grid of quick access buttons for common folders, such as Music, Documents and Pictures – but when they all sport the same icon and there's no label, as was our experience with the default theme, you have to hover over each one and wait for its name to appear in a tooltip.

If you don't get on with the default desktop, there are other themes to choose from, including some with more traditional window controls.

The Calamares installer is logical and offers plenty of guidance, such as the requirements for a secure password. Once up and running, you might not recognise a huge number



**ABOVE** Firefox is one of the few instantly recognisable apps

strengthens security and minimises points of failure. It should also mean that if an update fails your machine remains bootable. Other security measures have been implemented elsewhere, such as disabling core dumps, implementing strict password expiration and deactivating

**There's a lot of interesting technology in this distribution, and it's refreshing to encounter such an individual interface**

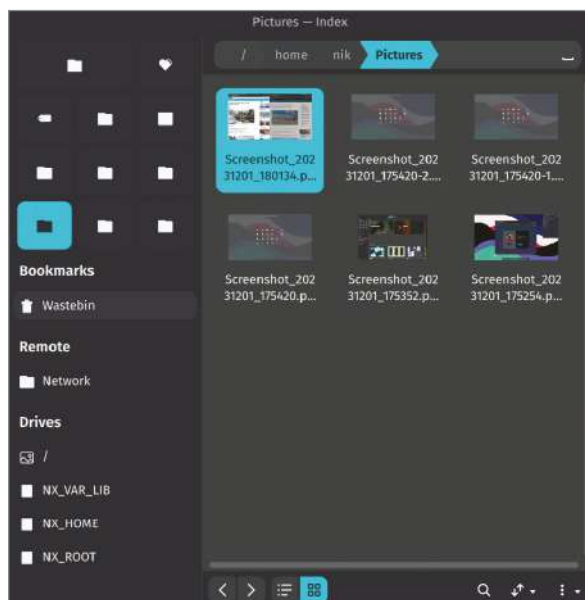
the root account. There's a built-in backup tool – Kup – that can be set to kick in after you've been using your computer for a set period, which is an unusual and useful option.

The X11 display protocol has been dropped in favour of Wayland, providing a shorter and more secure route between application and display. One happy benefit of the switch to Wayland, which is taking place across most distributions, is a probable speed bump, and certainly Nitrox feels fast in everyday use. This was particularly evident when we were browsing the web, with pages seeming to arrive more quickly on our domestic broadband connection than they do in other Linux distributions or on our Windows box. We suspected that our broadband had been upgraded (and checked), but that wasn't the case.

There's a lot of interesting technology in this distribution, and it's refreshing to encounter such an individual interface. Going down this road is a brave and largely successful move that has garnered significant praise, including from our sister site **TechRadar.com**, which named it the best Linux distro for new users.

However, with this review written, we're now looking forward to returning to a more conventional environment.

**BELOW** Buttons in the file manager provide access to folders, but they're not labelled



## openSUSE Tumbleweed

If you prefer the KDE interface and like living on the cutting edge for updates then give Tumbleweed a try

SCORE ★★★★★

WEBSITE [get.opensuse.org/tumbleweed](http://get.opensuse.org/tumbleweed)



It's not unusual for Linux distributions to be available in several builds. Ubuntu has long-term support and cutting-edge editions, Zorin has Core and Pro builds, and openSUSE has Tumbleweed and Leap. Tumbleweed, which we're reviewing here, is a continuously evolving build comprising the latest stable version of each component, which is updated as and when new code appears. Leap, which is based on SUSE Enterprise Linux, is a stable release that receives periodic updates.

The version that we installed was running the 6.6.3-1 kernel (the very latest build was 6.6.4 at the time of writing), and is available with a choice of desktop managers, including Gnome, Xfce, Cinnamon, Mate and KDE Plasma 5, the latter of which tops the installer's list of options. That's therefore what we chose for our tests. In our installation, this sat on top of the X11 Window System rather than Wayland.

As well as the regular 64-bit and 32-bit builds for desktop use, there are alternative builds for ARM, IBM Z family mainframes, RISC and PowerPC. It will also run on Raspberry Pi.

The installer is logical, but not the most friendly on test. Setting up Wi-Fi requires that you know which security protocol your network uses, and we failed on our first three attempts to boot into openSUSE at the end of the process. Despite the installer apparently completing, our test machine still attempted to start the OS we had previously tested. We solved this by forcing the installer to delete all partitions on our internal drive even if it thought that wasn't necessary.

Once it was up and running, however, everything was far more logical, and there were only ten updates ready to download,

reflecting the fact that the installer was still fresh, having been downloaded just the day before. A further 11 appeared later in the day.

It's not only core components such as SAMBA, git and the kernel that receive rolling updates in Tumbleweed: bundled applications are likewise cutting edge. Thus, at the time of writing we found LibreOffice 7.6.3.1 and Firefox 120 pre-installed. Email is handled by Kmail, but if you prefer Thunderbird, the version accessible through Discover, openSUSE's software manager, is version 115.5. The versions of GIMP and Inkscape available through the manager, both of which are options rather than pre-installed software, match the latest releases available through their respective sites.

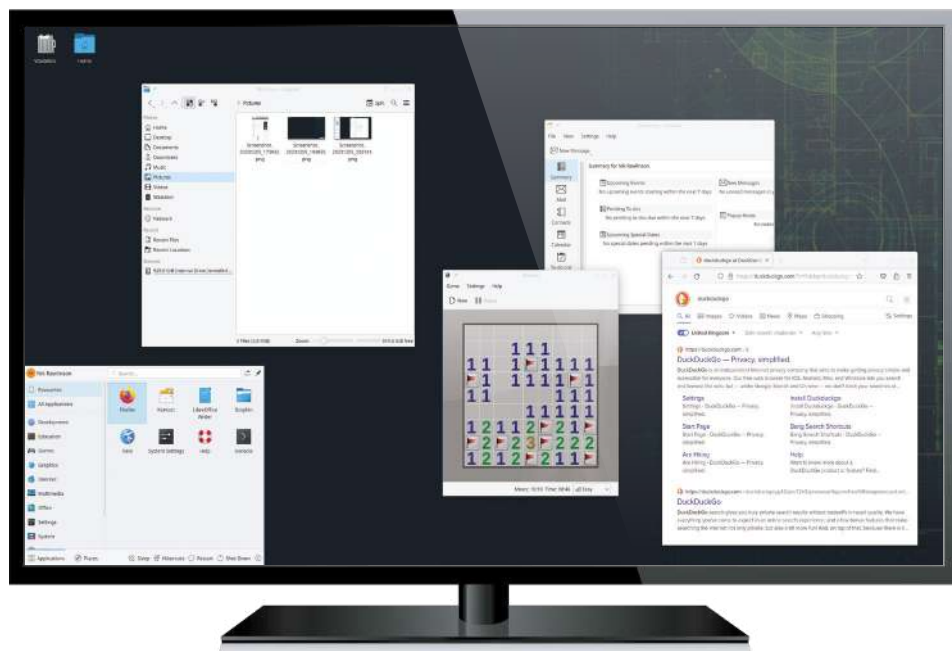
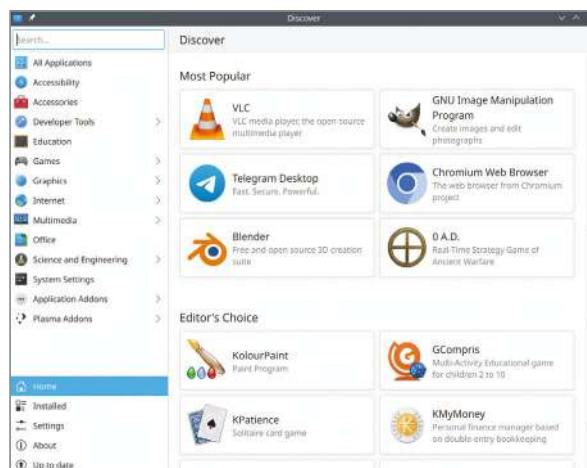
KDE Plasma should be familiar to anyone switching from Windows, as it features a traditional taskbar and menu. Commonly used applications can be pinned to the bar for easy access, and menu options are filtered as you type to reduce the number of matching applications.

**ABOVE** The openSUSE interface is logical and accessible



**KDE Plasma should be familiar to anyone switching from Windows, as it features a traditional taskbar and menu**

**BELOW** The installer is logical, but not the most friendly on test



Plasma lets you add secondary toolbars, and also features widgets, with a generous selection pre-installed but dormant. We saw this implementation in NitruX, which also uses KDE Plasma, although in a significantly tailored form. For our money, the version seen here, where window controls remain attached to the windows themselves, feels more logical.

The comprehensive settings app is supplemented by YaST (Yet

another Setup Tool), which provides password protection for more sensitive options, such as configuring the boot loader, administering printers and managing users.

Tumbleweed scored 1,167 in the single-core Geekbench tests and 3,241 in the multicore benchmark. This puts it broadly in line with the other distributions on test, suggesting that deployment decisions would be better based on factors other than performance.

openSUSE is one of the oldest Linux distributions still being actively developed but, with Tumbleweed, you'll always be running one of the newest builds available. This is its primary appeal, since other factors such as the choice of desktop managers, and pre-installed applications, are common to many rivals. Although we initially experienced some difficulty with installation, your mileage will likely vary and, once up and running, it was regularly updated – as promised – and as stable as any other distribution on test.

If your preference is for KDE, rather than Gnome, this would be our pick of the bunch.





# Rocky Linux 9.3

This spiritual successor to CentOS packs some decent punches, but ultimately falls short of Fedora

SCORE ★★★★★

WEBSITE [rockylinux.org](https://rockylinux.org)



**R**ocky Linux is one of the youngest distributions around, first appearing in mid-2021. It's based on Red Hat Enterprise Linux, so in some ways is a natural home for anyone previously running CentOS, a community-supported version of Red Hat terminated in December 2020.

Rocky's first release was version 8.3, reflecting the fact that it was based on the same version of Red Hat Enterprise Linux. The version-8 line remains current, despite 8.9 appearing two days after 9.3, which itself is based on Red Hat Enterprise Linux 9.3. That's the version we're testing here. Planned end of life for the Rocky 9 line is May 2032. For Rocky 8, it's May 2029.

Red Hat Enterprise Linux uses Fedora source code in its development, so Fedora and Rocky naturally share several touch points. However, where Fedora 39 is built on the 6.6.3 kernel, Rocky Linux 9.3 is built on the same 5.14 Linux kernel as Red Hat 9.3. While this may look outdated, it shouldn't be an issue, as Red Hat uses a system known as backporting to implement fixes and features within the existing kernel while maintaining compatibility with overlaying applications.

Installation is straightforward. There's no media builder as there is for Fedora, so it's a case of downloading the ISO and using balenaEtcher or similar to write it to a bootable thumb drive. The full DVD ISO is a hefty beast, tipping the scales at 9GB. However, there are lighter "boot" and "minimal" builds that can be used to enter rescue mode and install the OS from an alternative source, like an online repository. There are four processor builds, covering x86\_64, ARM, PowerPC and IBM s390x servers (although only the first two of these are available for Rocky 8). Dig deeper and you'll find a build

specific to Raspberry Pi in the alternative images library.

Although Gnome is the default window manager, you can swap it out for KDE, Xfce, Mate or Cinnamon.

We opted for the DVD ISO and, once up and running, were dropped into Gnome 40.4, which feels dated if you're accustomed to Gnome 45. Aside from the operating system, we didn't have much to show for our 9GB download. Firefox was pre-installed, but there was no email client, office suite or image editor. These are all available through the Software app, and we were glad to see that the version of Thunderbird available through the repository was 115 (which benefits from a significant

**ABOVE** Other than Firefox, very little is installed at first

**It's based on Red Hat Enterprise Linux, so in some ways is a natural home for anyone previously running CentOS**

**BELOW** The software installer doesn't always have the most recent version of apps

redesign). However, LibreOffice, had we chosen to install it through the default repository, would have been version 7.1 (the latest build is 7.6), GIMP was one point behind the latest build, and Inkscape was at 1.1.1, while its latest stable release is 1.3.2.

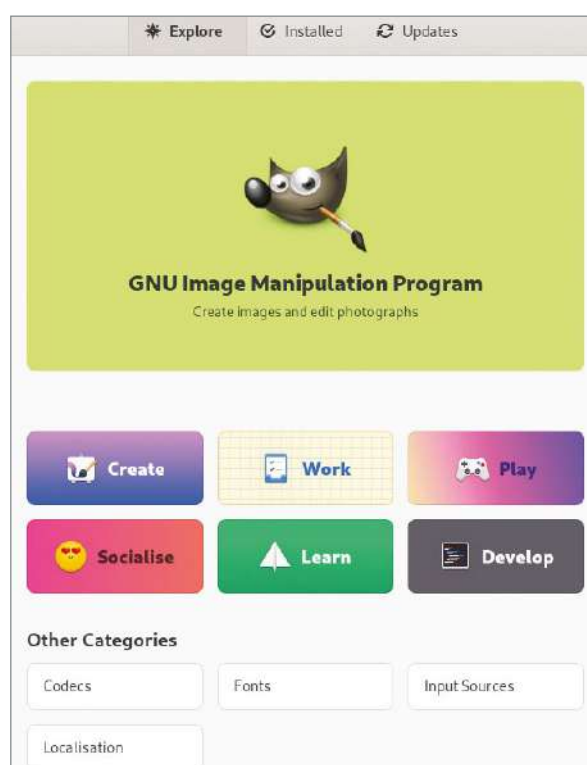
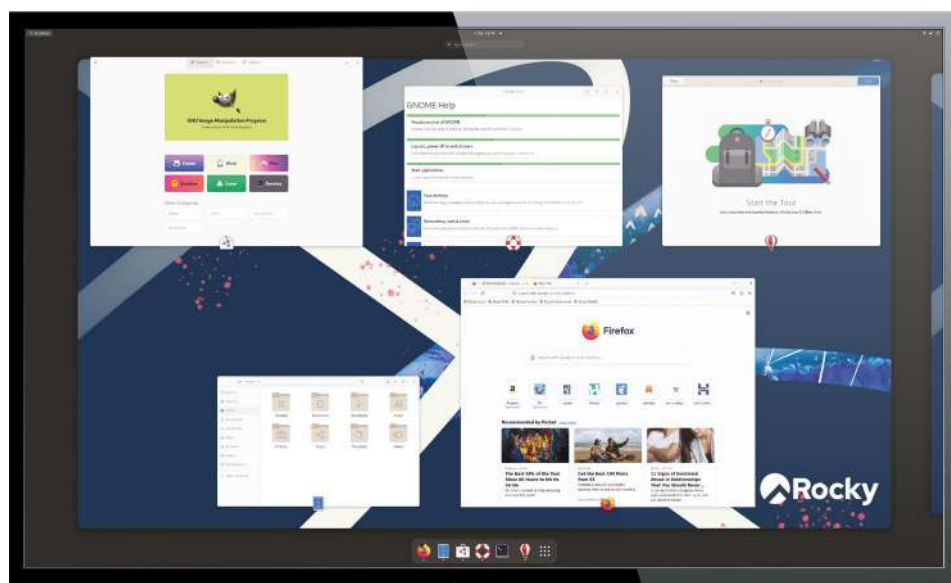
Further hurdles: the two printers on our network hadn't been recognised upon first booting and updating the

system, and we needed to enter their IP addresses in the printer setup dialog to add them to the OS.

Less rocky was this distribution's turn of pace. Rocky Linux 9.3 returned a respectable 1,097 in the single-core Geekbench test and 3,112 in the multicore test. Despite the different kernels, this was broadly similar to the scores we saw when testing under Fedora, which turned in 1,105 and 3,053 respectively. In either case, we would be surprised if this made a noticeable difference in day-to-day use.

It's perhaps unsurprising that our verdict is so similar to that for Fedora, which was our runner-up to Ubuntu. They are, after all, the bread in a Red Hat sandwich, sitting at either end of the development chain. If you don't want to run a Debian-based OS, either would be an excellent choice, being well supported and closely aligned to one of the pre-eminent commercial Linux distributions.

Of the two, we would opt for Fedora. There are three reasons why. First, it got us up and running more quickly. Second, for bundling Gnome 45. And third, for including a wider range of pre-installed default applications, each running a recent build.



## Ubuntu Desktop 23.10

This most familiar (and user-friendly) of Linux distros triumphs overall and for Gnome fans in particular

SCORE ★★★★★

WEBSITE [ubuntu.com](https://ubuntu.com)



Debian-based Ubuntu is the jumping-off point for many other distributions, including Linux Mint and Zorin OS. The Desktop edition is available in at least two builds: the so-called LTS (Long Term Support) build, which receives support for a minimum of five years from release, and the bleeding-edge release, which comes with nine months of security and maintenance updates. In each case, the build number – 23.10 in the case of this review – denotes the year and month of release, so 23.10 will enjoy support until July 2024, and 22.04 LTS until April 2027. New releases appear every six months for the cutting-edge build, and every other year for the LTS edition.

Both 23.10 and 22.04.3 LTS require 4GB of memory, 25GB of drive space and a 2GHz dual-core processor, despite running on different kernels (6.5 versus 5.17) and desktop environments (Gnome 45 versus Gnome 41/42). Build 23.10 is also running more up-to-date versions of its default applications, Firefox, LibreOffice and Thunderbird. Of these, perhaps the most significant is Thunderbird, which sits at 91 in the LTS release and at 115.2 in 23.10. Thunderbird 115 introduced significant interface improvements and, even if you install the LTS release, we'd recommend updating Thunderbird to at least 115 yourself.

As well as the desktop edition, there are builds for server and IoT platforms, with the latter including Raspberry Pi. The Pi edition is available directly through the Raspberry Pi Imager. There's also an immutable build, in which the core system files are protected against tampering.

None of the installer's questions is too taxing. You don't need to know what kind of security your network uses, as you do for openSUSE, and we didn't need to play around with

the partitioning of our drive to complete the process successfully.

Once up and running, you're presented with a largely vanilla workspace. Although Ubuntu has its own style, it remains fairly faithful to Gnome's default look and feel, rather than making a significant departure as Zorin does (or as Nitrux does from KDE Plasma). If you don't like Gnome, you'll find alternative builds with a little searching. Kubuntu ([kubuntu.org](https://kubuntu.org)) switches it out for KDE, while Ubuntu Budgie ([ubuntubudgie.org](https://ubuntubudgie.org)) and Ubuntu Cinnamon ([ubuntucinnamon.org](https://ubuntucinnamon.org)) naturally use Budgie and Cinnamon respectively. Lubuntu ([lubuntu.me](https://lubuntu.me)), using Qt, and Xubuntu ([xubuntu.org](https://xubuntu.org)), using Xfce, are both Ubuntu-recognised ports for lower powered computers.

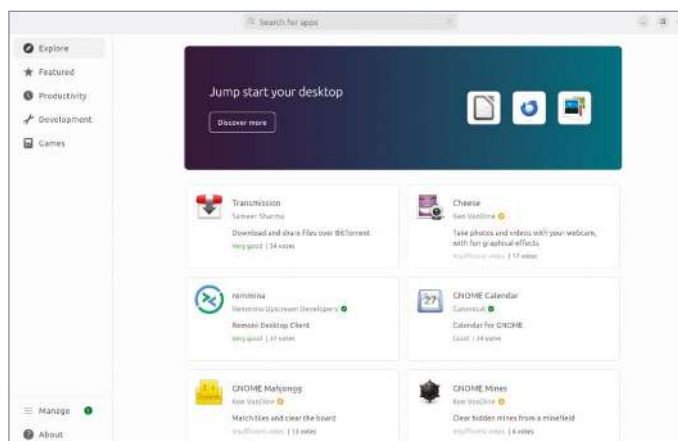
Apps can be installed using the built-in App Center or via the Terminal using apt. The App Center, which gives access to both Debian and Snap packages, has been upgraded in 23.10, and certainly feels more engaging than the installer it replaced. There's a handy "Jump start your desktop" at the top of the homepage that gives direct access to

ABOVE Ubuntu stays faithful to Gnome's default look and feel



For many newcomers, Ubuntu is a byword for Linux, and it's easy to see why. Installation is a breeze, and it just works

BELOW "Jump start your desktop" gives direct access to the most common apps



the most commonly installed apps, rather like the recommended software section in Raspberry Pi OS. Other named sections, including a Productivity section, make it easy to find essentials such as alternative browsers, Bitwarden and Slack. Neither Inkscape nor GIMP are preinstalled, but the versions available through App Center match the latest-edition version numbers available from their respective sites.

More good news? On first boot,

both of the wireless printers on our network were successfully recognised and set up.

For many newcomers, Ubuntu may well be a byword for Linux, and it's easy to see why.

Installation is a breeze and, once complete, it just works. The new features in this latest release, including the updated App Center and Gnome 45, are subtle but welcome improvements over their predecessors, and the default interface is unflashy and provides few distractions.

Ubuntu was our Labs Winner last

time around, and nothing changes here – so long as you're happy running Gnome. If you aren't, take a look at KDE-based openSUSE Tumbleweed or Cinnamon-based Linux Mint.

It's not difficult to find an Ubuntu-based distribution running KDE, Budgie and several other desktop managers, although, as they're not directly controlled by Canonical, the company behind Ubuntu itself, it's fairer to consider them different products.





## Zorin OS 17

This Windows 11-like distro is a great choice for switchers, with a Pro option available for under £50

SCORE ★★★★★

WEBSITE [zorin.com](https://zorin.com)



**W**ant a pretty OS? Look no further. Zorin comes as close as any operating system to rivalling Windows 11's featherweight fluid design. We're testing the free Zorin OS Core, but there are alternatives for older computers (Zorin OS Lite) and professional users (Zorin OS Pro).

Lite switches the highly customised Gnome 43 desktop environment for Xfce, while Pro, which costs £39 exc VAT, bundles installation support and additional software for image editing, 3D graphics, video editing, note taking and more. Pro can be installed on multiple computers with a single licence, unless you're a business or education user, in which case you'll need a licence for each machine.

Whichever version you choose, Zorin is based on Ubuntu, with the latest build running on the 6.2 kernel. Support runs until at least April 2027.

Linux Mint is often touted as the best Linux for Windows switchers, and certainly it takes very little time to become comfortable with its Cinnamon desktop. However, for our money, Zorin is better yet. The default UI has the taskbar and Start-style menu of both Windows and Mint, and the colour scheme is immediately familiar. It's supplemented by three other themes, with one adopting the traditional Gnome shell and another optimised for touch – and, if you upgrade to Zorin Pro, you get additional desktop styles, including more explicit Windows 11, macOS, Chromebook and Gnome 2 options.

You may be able to bring some of your Windows apps with you, with optional Windows App Support, which uses Wine and its graphical

front end, PlayOnLinux. However, you can install these yourself on other distros (and Nitrix has it built in, in the form of Bottles), so they're not a reason to choose Zorin in their own right – and Windows application support isn't 100%, so don't expect to be able to run everything you rely on today. That said, the one-click setup may well make this implementation a tempting one for less confident switchers.

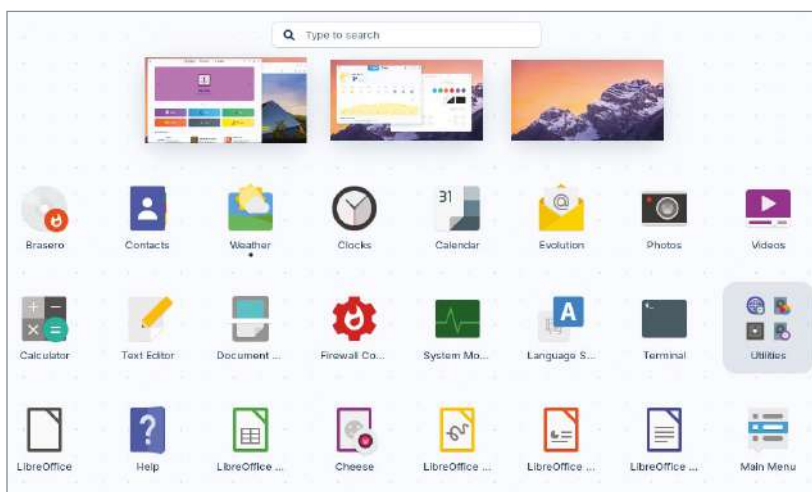
Zorin introduced an upgrader with version 16.3, which was simultaneously rolled out to existing version 15 installations. This preserves your files, apps and settings when you make a full-point upgrade. Previously, such upgrades required a clean start and manual migration. It sits alongside a carefully curated selection of default software. LibreOffice 7.6.3 is preinstalled, but GIMP isn't. The default browser is Firefox, and for email it's Evolution. This is a good-looking alternative to Thunderbird, but with the latter receiving a significant brush-up in its 115 release, we're inclined to switch,

**ABOVE** The default UI has a taskbar and Start-style menu



**If you're new to Linux and nervous about switching, Zorin could be just the distribution you've been searching for**

**BELOW** The app store can use Zorin and Ubuntu repositories, Flathub and Snap Store



simply so we can run the same client on both Linux and Windows.

Both the Core and Pro builds include Zorin Connect, which maintains an encrypted local-network connection between your computer and an Android phone. You can sync notifications, share files, and control music and video playback across devices. You can also use it to turn your phone into a remote keyboard and mouse, or a controller for PC-based presentations. If you want the same features in an

alternative distribution, check out KDE Connect ([kdeconnect.kde.org](https://kdeconnect.kde.org)).

You can download anything that's not preinstalled from the integrated app store, which is set up to use Zorin and

Ubuntu repositories, Flathub and Snap Store. This all makes for a friction-free environment for Linux newbies, and we were pleased to see that both printers on our network were recognised on first boot.

If you're new to Linux and nervous about switching, then, Zorin could be just the distribution you've been searching for. It looks great, feels immediately familiar (even if you don't pay for the Windows 11-style UI of Zorin Pro) and goes to significant lengths to simplify working with your mobile – so long as it's running Android – and integrating (some) Windows applications. It feels like the best Linux distro for Windows switchers who want to quickly feel at home.

# View from the Labs

If there's one thing this Labs shows, it's that Linux is now far easier to install – and a mature alternative to Windows and macOS

It's been four years since *PC Pro* last ran a Linux Labs (see issue 308, p78). Much has changed since then – and all for the better. On that occasion, I performed the tests on a Core i3-based Dell Inspiron laptop, and some distributions had trouble connecting to Wi-Fi. The laptop had no Ethernet port, and the only fix was to connect to a mobile hotspot once the OS had been installed so I could download some hefty updates. Support for the trackpad was likewise patchy, and it was occasionally unresponsive upon waking up.

That laptop is still in daily use, and still running Linux – flawlessly now – but wasn't called up for duty this year. This time around, I used a mini PC with an AMD Ryzen 5 3500U processor. Although it has an Ethernet port, I didn't touch it, as none of the distributions had any problem connecting to Wi-Fi, even if they were running a dedicated installer rather than a live boot environment.

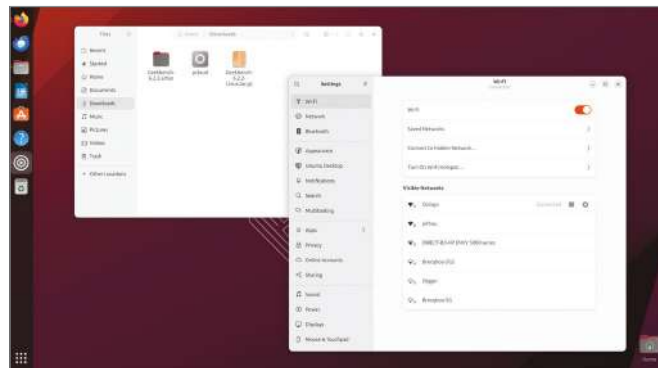
This demonstrates how far things have come. You'd expect the odd glitch when comparing eight diverse operating systems, with a hotch-potch of kernels and mismatched window managers, and the fact that I haven't hit any problems can be taken as a sign that Linux's time has come.

What do I mean by the "time has come"? Linux has been with us for more than 30 years, and Unix for more than 50, after all. However,



Nik Rawlinson is a former editor of *MacUser* but switched to Linux after writing 2019's Linux labs

**"I wouldn't steer you away from any of the distros on test. They're all up to the job of keeping you productive day to day"**



**LEFT** All of the distros on test connected to Wi-Fi without any issues

until now, it has frequently been something that mainstream users would only consider once their hardware was too old to run the latest version of Windows. That's happening less and less. Windows is getting

better at running on conservative specs, and computers are lasting longer. For many, the day when Linux is the only possible fallback may still be years away. For some, it might never arrive.

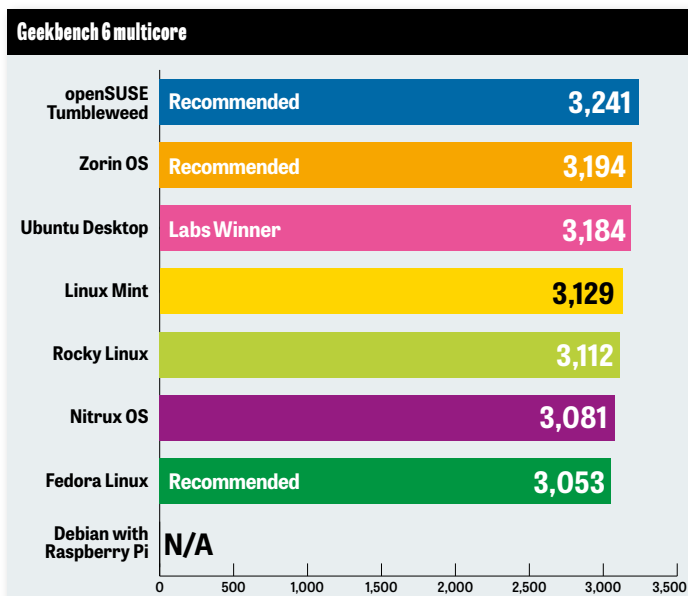
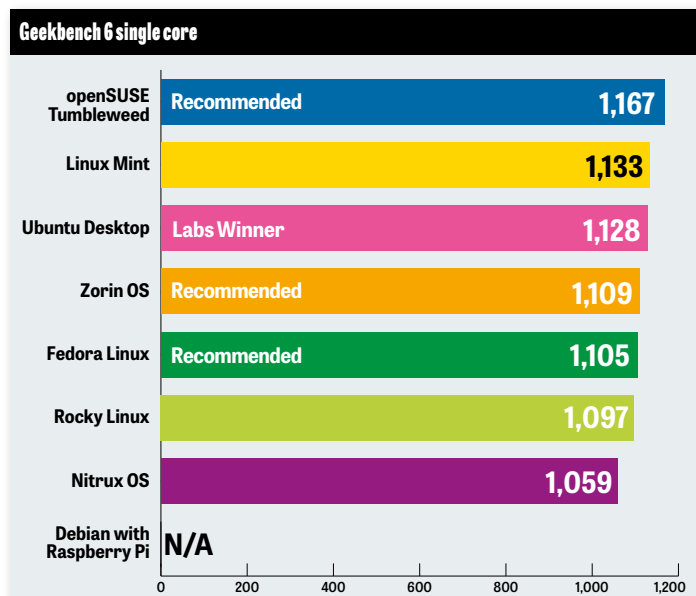
So, why not consider Linux from the outset, as an alternative to Windows and macOS, not merely their eventual replacement?

When grading eight operating systems that perform close to flawlessly, I've had no choice but to amplify small differences. So, while I've chosen a winner, I wouldn't steer

you away from any of the distros on test. They're all up to the job of keeping you productive day to day, whether at home or in business, and compatibility with specific applications is becoming less important as more work than ever is done through the browser.

Whatever your reasons for switching to Linux, there are several ways to go about it. A small number of manufacturers produce Linux-native hardware. Others will custom-build a machine without pre-installing an operating system. Or you could buy a regular Windows machine and wipe it. The last of those was more or less the approach I took, although rather than wiping the drive, I swapped it for a blank SSD. That way, when the time comes to upgrade, I can replace the original Windows drive before selling, donating or passing it on. ●

## Test results





# The Network

Practical buying and strategic advice for IT managers and decision makers

## Buyer's guide

# Network-monitoring software 2024

Take the pain out of firefighting networking issues with software dedicated to the task. Dave Mitchell explains what to look for and reviews four contenders



**H**ealthy business networks are productive ones, and it's imperative that IT departments keep them that way. Downtime is a dirty word: it can cause a loss of productivity, while prolonged service outages may lead to irreparable damage to a company's reputation and customer perception.

As networks become interconnected and ever more complex, support staff need all the help they can get if they want to avoid a daily firefight. Network-monitoring software is ideal as it can tell them precisely what's on their networks, how it's performing and alert them to any issues as soon as they happen.

The good news for IT departments is that there are plenty of products available all capable of providing a wealth of information about network, device and application health. This month, we review four affordable monitoring solutions – namely ManageEngine, Mutiny, Paessler and Progress Software – and test them in our lab to help you make the right choice.

### Health and safety

To allow the monitoring software to gather detailed device health information, some preparatory work is required that won't affect general operations. Infrastructure devices such as switches and routers require the SNMP (simple network management protocol) service manually enabled, as for security reasons, this is usually disabled by default.

If possible, use the secure SNMPv3 as its traffic is encrypted and it requires the monitoring software to authenticate with a device. Many

**BELOW** WhatsUp Gold uses slide decks to give staff NOC views



networks will have legacy devices that only support the less secure SNMPv1/v2, but you can tighten it up: instead of using the well-known "public" read-only community name, pick one that isn't easy to guess, and don't provide a write community name as this isn't required.

The Windows management instrumentation (WMI) service is Microsoft's standard method for monitoring Windows servers and workstations, and you'll need to provide your monitoring software with valid user account credentials. WMI is enabled by default and provides far more system information than SNMP, such as running services, processes, Hyper-V operations and even the status of Windows Updates.

If required, you can use SNMP on Windows Servers, which is installed from the Server Manager app. Note that Windows only supports SNMP v2 so you should use the security tab in the SNMP service properties page to set a non-guessable read community name and configure it to only accept queries from the monitoring host.







# ManageEngine OpManager Professional 12.7

OpManager presents a big network-monitoring toolbox in a smart web console, and all at a good price

SCORE ★★★★★

PRICE 50-pack, \$645 per year from manageengine.com

A key player in the Zoho software and services empire, ManageEngine offers a wide range of IT management solutions. The OpManager product family delivers network, server and application performance monitoring, and ManageEngine version 12.7 delivers plenty of new features.

There's a focus on compliance and security, with support for single sign-on using security assertion markup language (SAML) and SNMP 3 with tougher SHA-2 authentication. Root cause analysis (RCA) profiles compare data collected from multiple devices to help with problem remediation, Cisco ACI, IPMI and VPN monitors are present and OpManager integrates with Slack and Microsoft Teams for alert notifications.

ManageEngine's flexible licensing schemes are good value for SMBs as they're based on devices, not elements or sensors. The OpManager Standard edition costs £195 per year for ten devices and provides availability, interface and SNMP/WMI monitoring services, with the Professional edition on review adding features such as virtualisation host monitoring.

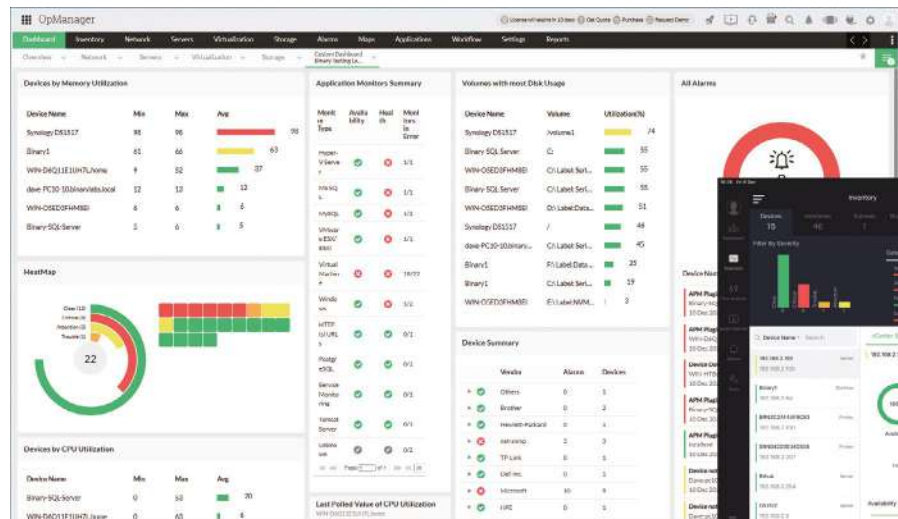
Along with perpetual licences, they're also all available as Plus versions that include OpManager's

add-on modules at discounted prices. For example, Professional Plus starts at £983 per year for 50 devices and includes network configuration management (NCM) and NetFlow analysis (NFA), along with firewall and application management.

Whichever edition you choose, you won't wait long to see it in action: it took us 20 minutes to install it on a Windows Server 2022 host and run an initial scan of the lab's IP subnet. For device identification and classification, OpManager is a veritable sleuth as it's endowed with over 11,000 device and 56,000 vendor templates.

It had no trouble figuring out what our lab devices were, correctly identifying all our Windows servers and workstations, routers, switches, NAS appliances, VMware and Hyper-V virtualisation hosts and printers. Adaptive alert thresholds are assigned to devices where OpManager uses machine learning algorithms to adjust them for you, and they can be linked to a range of actions using the integral drag-and-drop workflow builder.

The OpManager web console and its multitude of dashboards is capable of presenting a lot of information about your network, with the handy



**ABOVE** Dashboards can be customised to suit, and mobile monitoring apps are included



**“It may take time to get to grips with its myriad components, but OpManager is a powerful monitoring solution”**

heatmap widget showing a grid of coloured blocks representing each device and their status. Detailed custom dashboards are created by choosing from over 200 available widgets, and network operations centre views can present support departments with the big picture.

Virtual monitoring is extensive, as OpManager discovered our VMware ESXi and Hyper-V hosts and provided views of system and VM utilisation, guest OSes and datastore usage. Add the NetFlow module and you can view all common flows and use the free NetFlow Generator utility to translate raw packets into NetFlow data.

OpManager's RCA profiles are similar to the SolarWinds NPM PerfStack feature and are just as easy to create. The list of available metrics is very basic, but you can choose

devices and monitored items such as CPU and memory usage, add them to your RCA dashboard and view them all on one screen to help identify complex problems.

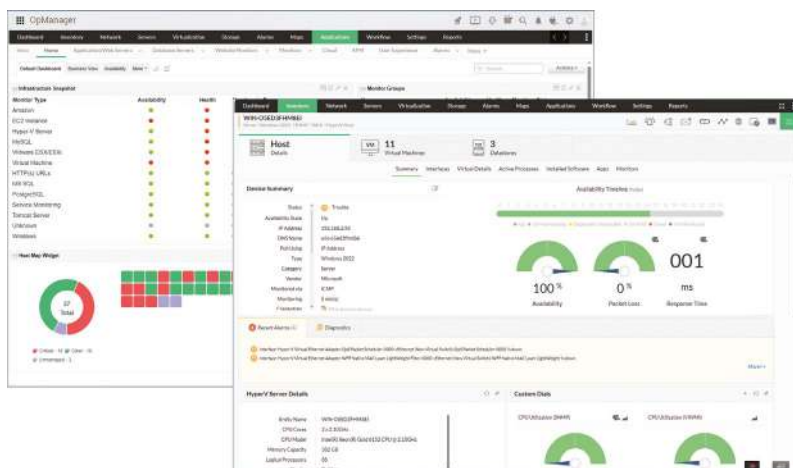
The Application

Performance Management (APM) plugin is a worthy addition as it monitors and reports on a huge range of apps. We used it to check on our AWS account, where it provided details on service availability, EC2 instance and S3 bucket status, plus monthly billing charges and forecasts.

It may take time to get to grips with its myriad components, but ManageEngine's OpManager is a powerful monitoring solution with a lot to say about your network. The web console is well designed and easily customised to suit, while SMBs will approve of OpManager's affordable licensing plans.

## REQUIREMENTS

Windows 10 • Server 2012 upwards • Linux



**LEFT** Virtual host monitoring is included in the Professional edition

## Mutiny Monitoring System

Mutiny is easy to deploy and delivers uncomplicated and efficient SNMP network monitoring at a fair price

SCORE

PRICE 300 nodes, £2,833 exc VAT per year from mutiny.com

If extreme longevity is a mark of success then Mutiny Ltd is a clear winner, as this UK-based company has now been in the network-monitoring business for 22 years. And for good reason, too: its Monitoring System is designed to hit the ground running with a simple installation and a fast network discovery process.

It's also excellent value for money. Licensing is based only on monitored nodes, regardless of the number of ports or elements each one has. Mutiny is totally transparent about costs, with the starting subscription price of £2,833 per year enabling 300 nodes, and you can scale right up to unlimited nodes for only £6,612 per year.

The Mutiny service offers plenty of deployment options: it can supply a turnkey 1U rack appliance with the software pre-installed, or you can download the CentOS ISO file for installation on your own choice of hardware platform. We took the virtualisation path and installed Mutiny's OVA file as a new VM on our VMware ESXi 7 host.

This took two minutes, after which we ran a console session to configure the virtual appliance's IP addresses and then swapped over to its web console. This is easy to navigate, with all the main

functions neatly grouped in a ribbon menu across the top.

Mutiny's discovery process is fast, and we used its Node Manager to add our IP subnet and SNMP read communities plus v3 credentials and left it to scan the lab network. In only one minute, it reported back with details of all our network switches, routers, NAS appliances, printers, Windows servers and VMware ESXi 7 hosts.

It added each node to our web console, assigned suitable icons to them for easy identification and automatically applied a default set of monitoring and alerting parameters with predefined thresholds. Mutiny currently supports SNMP, but it's in the process of adding native WinRM/WMI monitoring so it can gather even more information about Windows systems.

The console presents a set of informative dashboards that can be easily customised by adding new ones, assigning widgets and rows, choosing the resource views for each one and dragging them to the desired location. It also provides live

**ABOVE** The Mutiny dashboard is very informative and can be customised



**"In only one minute, it reported back with details of all our network switches, routers, NAS appliances, printers, servers and hosts"**

views of the top ten busiest systems and options to create geographical maps for various sites.

From the monitoring tab, you can check the status of all devices, and each is assigned one of four status indicators so you can see at a glance those that are up, down and are experiencing problems. Support departments can display this as a big status wallboard, and Mutiny claims to have the most efficient polling engine on the market that can check the availability and properties of over 16,000 devices per minute.

Value is decent: unlike much of the competition, Mutiny includes

integrated IP address management (IPAM) services as standard. Just add your IP address ranges and Mutiny shows you address usage and which systems are being monitored, along with

tools to export lists as CSV files.

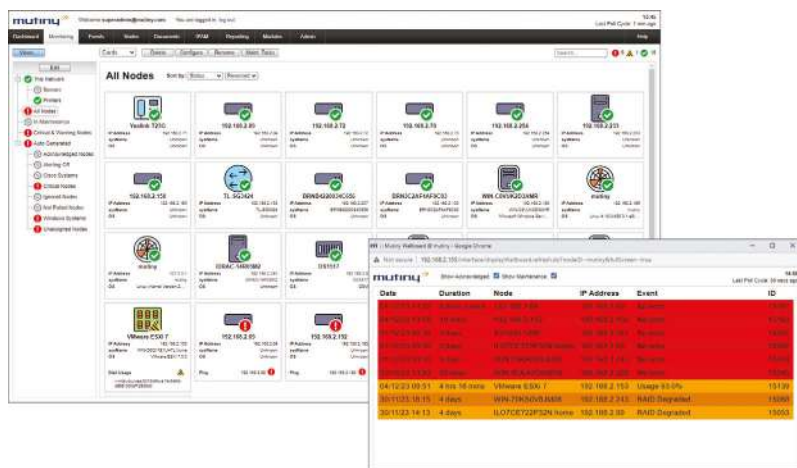
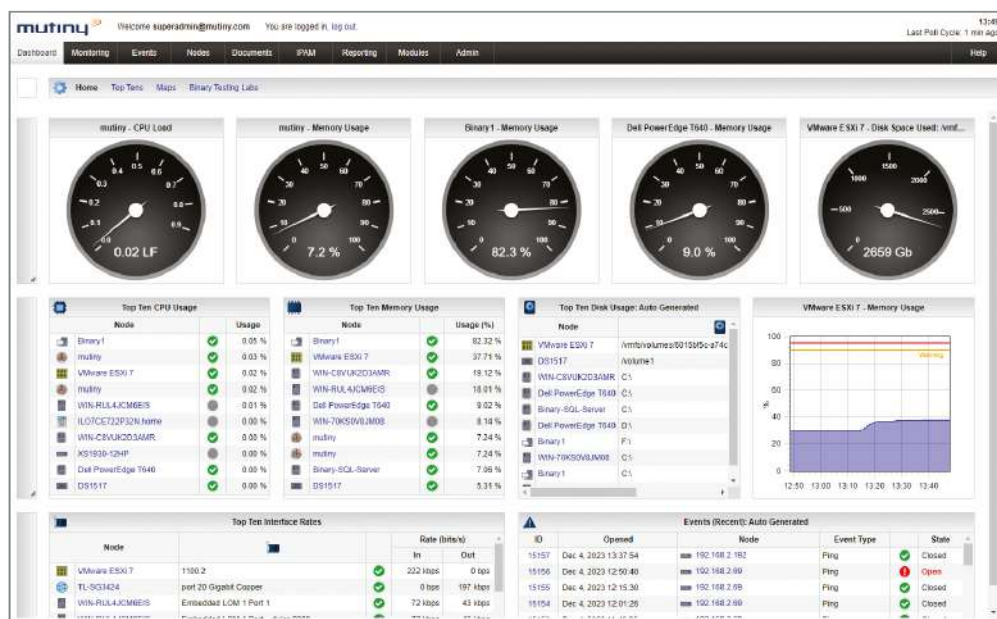
Busy support teams will appreciate Mutiny's versatile alerting facilities, which use primary, secondary and default shifts for every day of the week, where each shift has a start and end time that determines the order support staff will be called when a problem is identified. Mutiny supports SMS plus email messaging and offers a connector for sending alerts to the ServiceNow helpdesk app.

The Mutiny Monitoring System is a great choice for businesses that want a clear picture of the state of their networks. The node-based licensing is good value, it's incredibly easy to deploy and is capable of delivering a wealth of easily accessible information.

**LEFT** The console provides detailed device status views

### REQUIREMENTS

Turnkey appliance • CentOS ISO or OVA







# Paessler PRTG Network Monitor 23.4

A comprehensive and affordable solution that can watch virtually anything on your network

SCORE ★★★★★

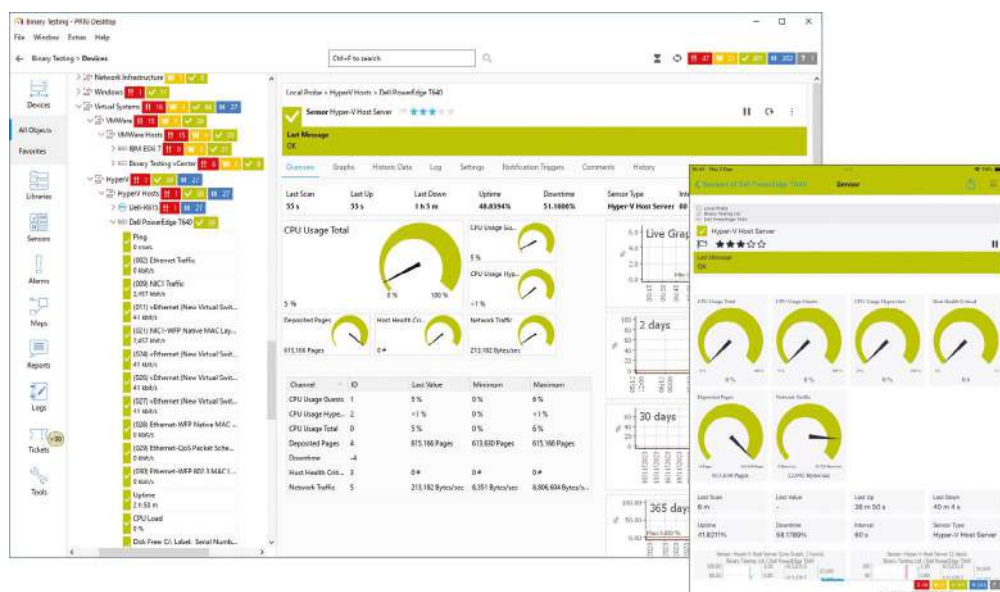
PRICE 1,000 sensors, 1yr maintenance, €2,649 exc VAT from paessler.com

**B**usinesses concerned about the cost of add-on components and upgrades can rest easy with Paessler's PRTG Network Monitor as everything is included in the price. Its sensor-based licensing means you just select the number you want and apply them to any device, individual hardware component, service or business application you choose.

Paessler offers a range of sensor packs. We've shown the price for a PRTG 1000 perpetual licence, which includes one year of maintenance and should be sufficient to monitor up to 100 devices. You can easily upgrade to larger packs when required, and Paessler also offers a free version with 100 sensors.

Businesses with distributed offices may prefer the cloud-hosted version where they remotely monitor each network by installing PRTG probes in them. This is a subscription service, with a Hosted 1000 pack costing €229 per month.

We've been running PRTG problem-free in the lab for over eight years, with all updates automatically applied on their release. New users will find on-site installation undemanding: after loading the software it runs a wizard to assist with your first network discovery, taking around 45 minutes to scan a complete IP subnet.



**ABOVE** PRTG's sensors deliver a vast amount of useful information



**"You can choose which components you want to monitor, delete those you don't need and requisition them for use elsewhere"**

Microsoft OneDrive monitoring have been discontinued, there's still an incredible range to choose from.

PRTG's web console provides a network overview showing the status of all sensors, and clicking on any of their icons next to the donut charts takes you to a filtered view. The devices view uses a tree structure, with all systems neatly organised into hierarchical groups that inherit settings such as login credentials and discovery schedules from their parent group.

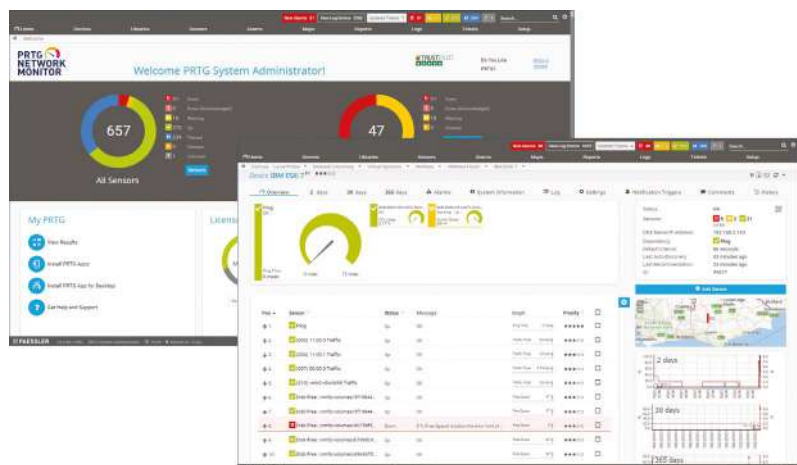
The view can be customised to suit your environment by adding new groups and moving monitored systems to them. It's easy to identify problems as all sensors are assigned colours showing if they are up, down, paused or in a warning state, and selecting one takes you to a detailed overview with live graphs and charts showing activity for the past two days, month or year.

Plenty of alerting services are provided, as notification templates are available for services such as email, SMS, Syslog, SNMP traps, MQTT, Slack and Microsoft Teams. You

can monitor PRTG on the move with Paessler's excellent iOS and Android mobile apps and use the Windows and macOS desktop apps to view the same levels of information as the main web console.

You'll need to keep an eye on consumption, but sensors make Paessler's PRTG a highly versatile network-monitoring package. It delivers a wealth of information about pretty much anything on your network, and its all-inclusive price makes it a great choice for SMBs.

**LEFT** The PRTG web console keeps you in the loop on sensor usage



**REQUIREMENTS** Core Server and Probe: Windows 11 • Server 2012 R2 upwards

## Progress WhatsUp Gold 2023.1

A great choice for SMBs, with a wealth of informative network-monitoring tools and flexible licensing plans

SCORE ★★★★★

**PRICE** Enterprise, 50 devices, £1,192 exc VAT per year from [whatsupgold.com](https://www.whatsupgold.com)

Progress Software has been busy developing its flagship network-monitoring software, and WhatsUp Gold (WUG) 2023.1 introduces a raft of new features with ease of use given a high priority. Previously, you had to manually enable monitoring for every device, but you can now set a network discovery scan job to do this for you.

What's more, the discovery process automatically collects SNMP and WMI device attributes and updates them in real-time, while WUG's dynamic SNMP table monitor populates every instance, making it easier to monitor specific devices. The device properties page clearly shows which credentials are being used, access security has been tightened up with TLS 1.3 support, and SQL Server Express 2022 is now the default database.

Licensing is even more flexible. Along with the standard versions, perpetual licences and points-based options, Progress has added three yearly subscription plans. The Business edition starts at around £715 per year for 50 devices and, unlike sensor- or element-based products, WUG doesn't care how many CPUs are in a host or the number of ports a switch has.

This edition supports 1,000 devices and includes core functions such as network discovery, topology



mapping, alerting and reporting, as well as cloud, wireless network and storage monitoring. The Enterprise edition has unlimited device support and enables virtualisation host and application monitoring plus log management, while Enterprise Plus adds network traffic analysis and configuration management for switches, routers and firewalls.

Installation on a Windows Server 2019 host took around 30 minutes, and discovery is swift. A wizard helped conjure up the first scan and, after we'd added all our device credentials, it took ten minutes to deliver a complete list of all our network devices.

The WUG console is easy to use. It presents four menu options in its upper ribbon bar, and you can add frequently used views to the Favorites tab by clicking on the star icon at the top right of the console. It's simple to create custom network discoveries, and you can pull up network topology views and maps.

Analysis dashboards are a great feature that allow you to design multiple custom views, add columns and choose the metrics you want to see. Anything WUG is

**ABOVE** The new NOC view provides a view of the network using slide decks



**“Analysis dashboards are a great feature that allow you to design multiple custom views and choose the metrics you want to see”**

capable of monitoring can be included, so you can create very detailed dashboards, and each device is assigned a coloured icon for instant status views.

The new network operations centre (NOC) feature manages collections of views that rotate to a schedule for presenting support teams with a big heads-up live status display. To create them, you click the same star icon, choose the NOC option, add items to a slide deck, enter a display duration in seconds and pass the URL to support staff so they can access it directly.

Alert policies link device state changes with an extensive range of actions including running a program,

restarting a service, sending emails and posting alert messages to Microsoft Teams users. The Alert Center presents even more information about disk utilisation, and the

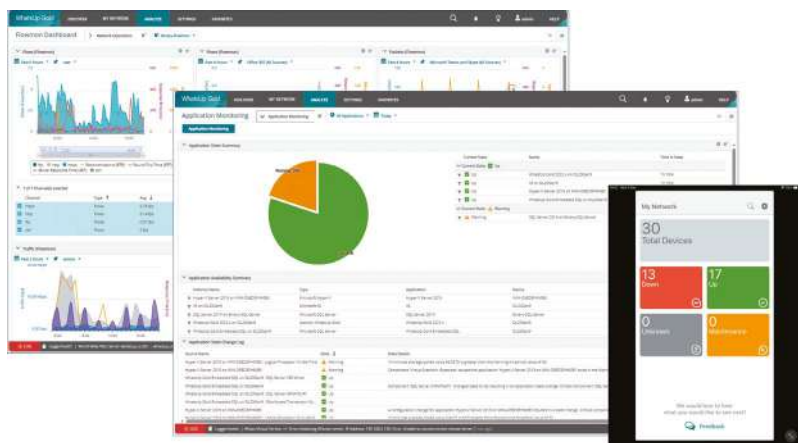
device properties page has been updated so you can see which actions have been applied to it.

WUG is a great choice for businesses running the Progress Flowmon appliances as it can monitor them and include their traffic analysis in its dashboards. General reporting tools are in abundance, too, and they can now be emailed in HTML format so non-technical users can appreciate them.

WhatsUp Gold 2023.1 is simple to deploy and offers an impressive range of network-monitoring tools. The choice of licensing plans makes it an affordable option for SMBs, and support teams will love its smart dashboard and NOC views.

**LEFT** WhatsUp Gold Enterprise shows Flowmon data plus app availability

**REQUIREMENTS** Windows Server 2016 upwards





## Jabra PanaCast 50

Delivers the big meeting room picture with great sound and vision plus classy remote management features

SCORE ★★★★★

PRICE £867 exc VAT  
from uk.insight.com

Jabra's PanaCast 50 video bar ensures that no-one feels left out, with its triple 13MP 4K camera turret presenting a full 180° horizontal field of view (FoV). What's more, lurking inside this 650mm wide cylinder is an 8-microphone beamforming array teamed up with pairs of 50mm woofers and 20mm tweeters.

Speaker tracking is a cut above the rest, too, as the PanaCast 50 incorporates no fewer than nine Edge processors, including two Edge AI chips. These allow it to provide integral video analytics, apply always-on people counting and use Jabra's Virtual Director technology to focus on the active speaker and zero in on them with its automatic 6x digital zoom.

The camera provides a USB-C port for BYOD meetings or connection to a permanent room computer. Jabra also offers two-room system solutions where one partners the camera with its Android-powered touchscreen tablet while another comes with Lenovo's ThinkSmart Core + Controller devices.

The kit includes a wall-mounting bracket, with the optional aluminium table stand costing £63. We also

checked out Jabra's Bluetooth remote pad (£39), which provides camera and audio controls plus direct access to whiteboard sharing.

We reviewed the model with a grey fabric cover, but Jabra also offers a black version for the same price. Whichever model you choose, you'll find integral Wi-Fi 5 services plus a 10/100 Ethernet port at the back for remote management using Jabra's free Xpress web portal.

BYOD installation is easy: you simply connect the camera to a USB port on a Windows or macOS host computer and wait for the drivers to load. It will work happily with any UVC-compliant VC app, but don't forget to download Jabra's Direct app otherwise you'll miss out on a wealth of features.

The app's camera controller window allows you to play with the image quality, set a zoom level, move the camera view and save two presets that can be accessed from the remote. From the general settings tab, you can control people counting, enable the Virtual Director and turn on the new dynamic composition feature, which puts the four most recent speakers in a split screen.

A large monitor is recommended, since the highest resolution is a very wide 3,840 x 1,080 pixels. The PanaCast's army of Edge CPUs come

ABOVE The three 13MP cameras offer a full 180° field of view



"Two Edge AI chips allow it to provide integral video analytics and use Jabra's Virtual Director technology to focus on the speaker"

BELOW The PanaCast 50 can be remotely managed and delivers superb video quality

into play here as they apply Jabra's patented video-stitching technology to produce a single image from the three camera feeds.

This works perfectly as we couldn't see any joins and the cameras deliver a pin-sharp image with great colour balance and contrast. Speaker tracking is very responsive, too: we could walk around our meeting room and, even without speaking, the camera followed us while we were moving.

Jabra's microphone expertise shines through. Remote participants could hear us clearly at a five-metre distance, and the quad speaker combo was just as impressive. Jabra won't beat Biamp's 2023 Excellence award-winning Parle VBC 2500 as the

PanaCast 50 lacks a little in the bass department, but it delivers a clean and clear sound quality with a 65% volume level quite sufficient for our 24m<sup>2</sup> meeting room.

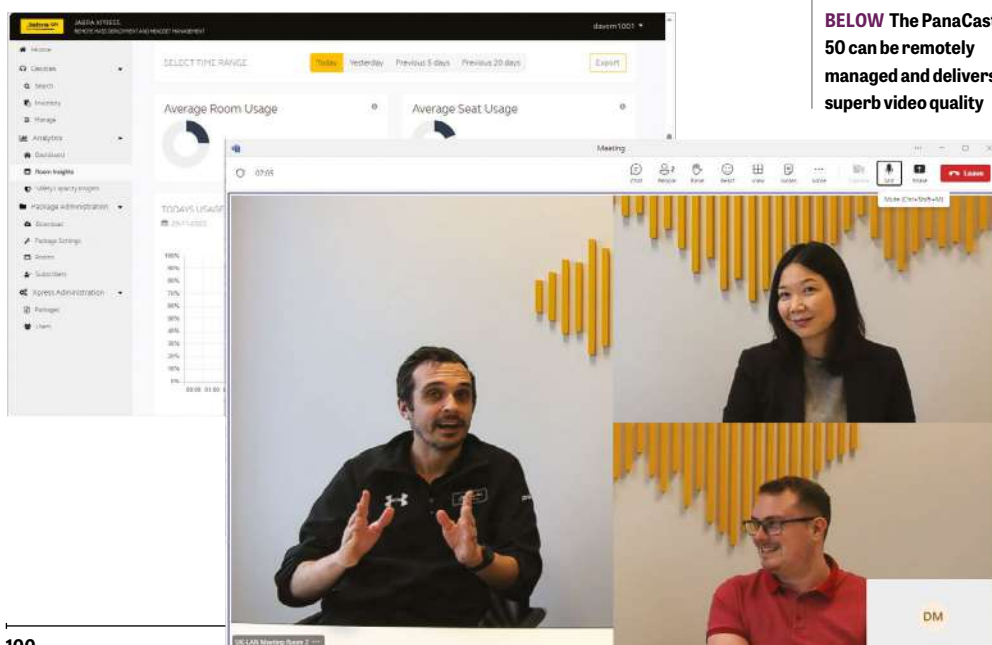
Remote monitoring and management are good, with the Xpress portal providing analytics on camera and room usage. "Packages" group camera settings together and, when you install the local Jabra Direct app, just copy a package URL to it.

You can remotely apply settings that override the local app. During room creation, you add a device serial number and apply maximum and safety participant capacities. The camera uses its people-counting skills to provide room usage details and will warn you if the room is over capacity.

This sleek cylinder delivers great video and audio quality, fast speaker tracking and a wealth of advanced features. Jabra's Xpress web portal offers smart remote management services, and the super-wide view helps make the PanaCast 50 ideal for all-inclusive meetings. **DAVE MITCHELL**

### SPECIFICATIONS

3 x 13MP 4K cameras • 180° horizontal FoV • 6x digital zoom • 8 x beamforming mic array • 4 x internal speakers • 10/100 Ethernet, Wi-Fi 5 • USB-C • Bluetooth • 2m USB cable • wall mount • external PSU • 650 x 125 x 80mm (WDH) • 2.2kg • 2yr limited warranty



## WatchGuard Firebox T45-CW

Businesses and remote offices that can't afford to go offline will love this feature-rich 5G security appliance

SCORE ★★★★★

PRICE Appliance with 3yr TSS, £4,015 exc VAT from broadbandbuyer.co.uk

WatchGuard's family of Firebox security appliances offers an unbeatable range of desktop solutions, and the T45-CW brings 5G failover to the table. Ideal for businesses that need always-on internet access for remote sites, its multi-WAN features combine wired and 5G mobile connections in a single policy so if one goes down, the other seamlessly steps in and takes over.

The T45-CW's quad-core 1.6GHz NXP CPU claims a high raw firewall throughput of 3.94Gbits/sec and 557Mbps/sec with all UTM services enabled. It has five gigabit ports for WAN, LAN plus DMZ duties and, unlike many table-top security appliances, it offers secure Wi-Fi 6 services.

The appliance delivers a wealth of security features, and it's easy to choose the right subscription as WatchGuard offers two options. A Basic Security Suite subscription enables gateway antivirus, anti-spam, web filtering, HTTPS inspection, IPS, application controls, WatchGuard's RED (reputation enabled defence) cloud-based URL filtering and network discovery.

We've shown the price for a three-year Total Security Suite subscription, which adds WatchGuard's advanced persistent threat (APT) blocker with



cloud sandboxing, DNSWatch for monitoring client DNS requests and blocking access to known malicious domains, IntelligentAV anti-malware services and ThreatSync XDR, which provides policy-based collection, correlation and automated responses for Firebox threat events.

Local management is simple. The web console runs a wizard to enable wired internet access, activate a basic security policy and create a wireless SSID. Our unit came with a Vodafone 5G SIM and, after enabling the internal modem, the SIM came online.

WatchGuard includes four SMA external aerials; LEDs on the front panel show the cellular signal strength, failover status and whether you have a 4G LTE or 5G connection. Configuring failover is a cinch: you use the multi-WAN feature to define primary and backup connections and decide how failback is handled.

In practice, it works perfectly. We set up a continuous ping to an external website and then pulled the wired internet cable. We saw a single ping timeout, after which it continued unabated, and when we plugged the WAN cable in again, the appliance swapped back to it without any ping timeouts being recorded.

Naturally, you can use 5G as your primary connection, and defining the modem as an external interface means all your security policies will be automatically applied to it. In fact, you can have both wired and 5G internet connections active and use

ABOVE The Firebox T45-CW has a wealth of security features



**"Configuring failover is a cinch: you use the multi-WAN feature to define primary and backup connections and decide how failback is handled"**

BELOW It can be managed locally or from the cloud

multi-WAN round-robin weightings to determine how connections are distributed across them.

For cloud management, we registered the appliance with our support account, allocated it to our site and chose the management and monitoring option. After reconfiguration, the T45-CW disables its local web interface, takes further settings from the cloud and provisions full access for remote configuration.

All security functions are easily accessible. From the portal's content scanning page, you use a simple slider bar to enable the gateway AV, IntelligentAV, APT blocker and spamBlocker services. Anti-spam policies are available for SMTP, IMAP or POP3 traffic, where you allow, deny or tag spam messages in their subject

line for ongoing local rule processing.

From the network blocking section, you can control botnet detection, IPS, custom blocked URLs and ports plus detection of

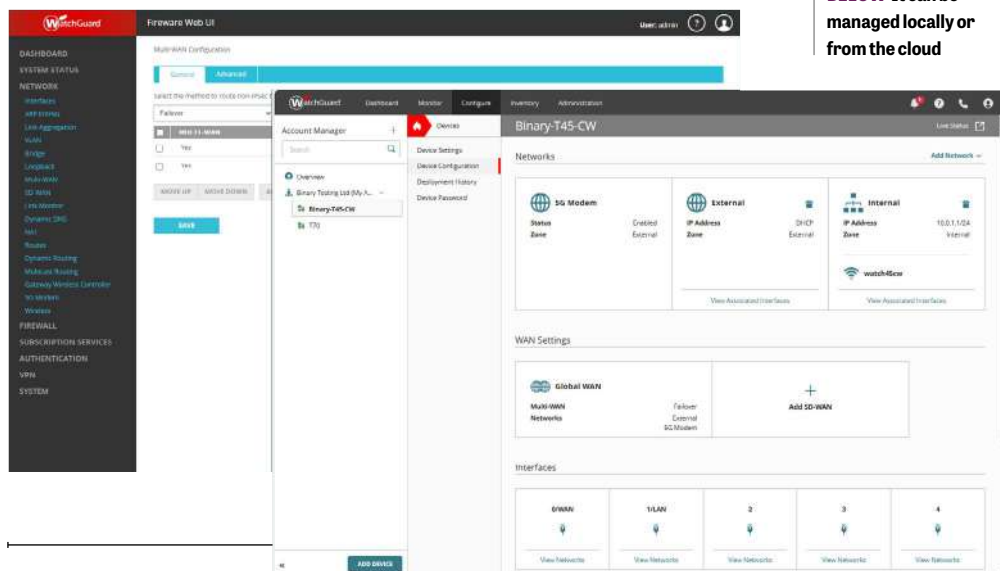
Tor (The onion router) exit points. Web content filtering offers 130 URL categories for blocking or allowing, while WatchGuard's application control service presents over 1,250 predefined app signatures.

The multi-WAN function is found in the device's networks page where you select the Global WAN option, choose failover or round-robin operations and set the failback mode. Move to the portal's monitoring page and you can see the status and strength of the 5G connection and view RSRP and RSRQ graphs.

Businesses that hate internet downtime will love WatchGuard's Firebox T45-CW. It provides a wealth of top-class security services, can be easily cloud managed and delivers seamless 5G WAN failover. **DAVE MITCHELL**

### SPECIFICATIONS

Desktop fanless chassis • quad-core 1.6GHz NXP LSIO43ASE7QQB CPU • 4GB DDR4 RAM • 16GB M.2 SATA SSD • 5G Nano SIM card slot • 5x gigabit (WAN, 4x LAN) • Wi-Fi 6 • USB-A3 • RJ-45 serial port • 4x SMA external antennas • external PSU • 216 x 203 x 46mm (WDH) • warranty included in subscription





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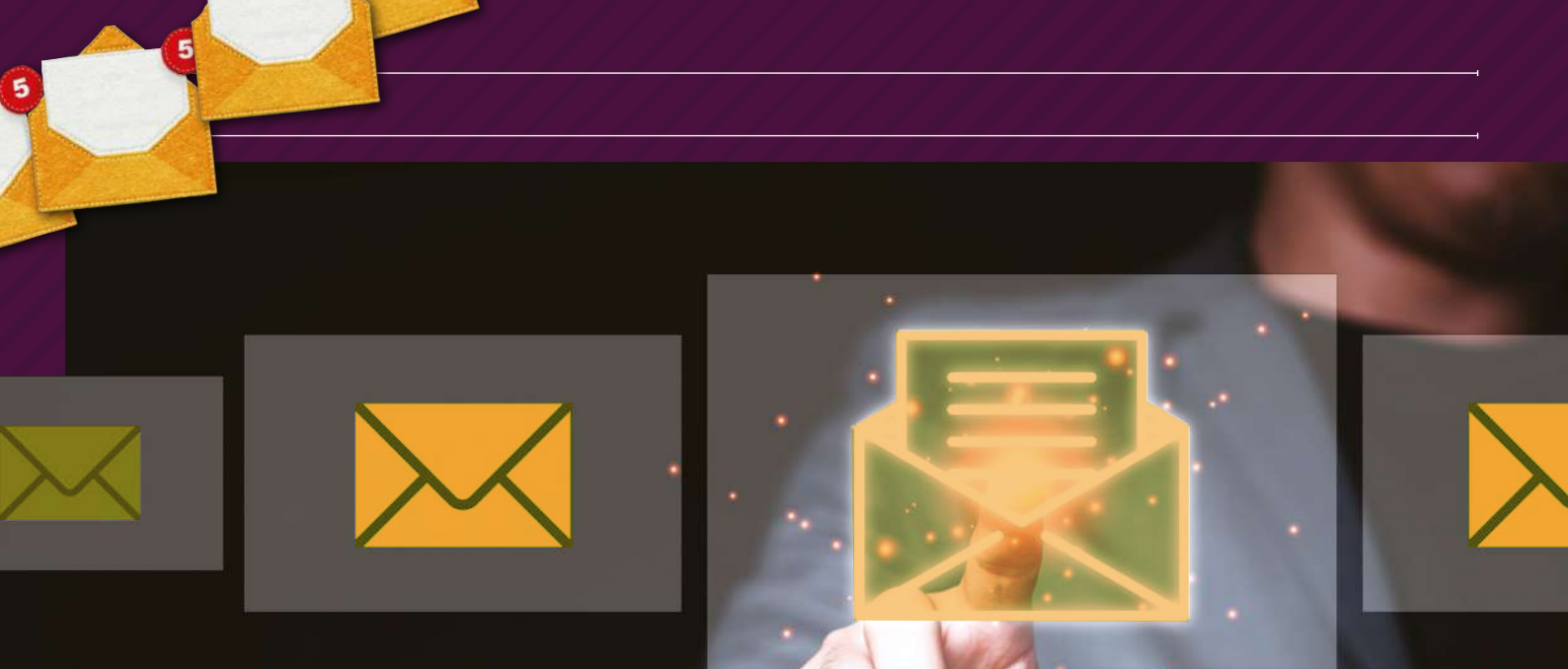
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-  Website Live Chat
-  WhatsApp & Facebook integration
-  Call center solution
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# Email marketing: how to do it right

The traditional mailing list is still one of your most powerful promotional tools. **Nik Rawlinson** explores how to make it work for you

**R**ay Tomlinson sent the world's first email in 1971 – and more than 50 years later, the medium is as popular as ever, with 4.5 billion users worldwide in 2024. According to ONS figures, it's the one thing Brits do online more than anything else.

One reason why email remains such a success is its universality. Email works equally well on smartphones, tablets and desktop computers, and it doesn't rely on proprietary apps.

For businesses, email is also one of the most direct ways to reach an audience. You have full control of your message and the means of its delivery; there's no need to game an algorithm or jump through arbitrary hoops to make sure your content is seen. The only barrier to entry is that you'll probably want to engage a third-party service to manage your mailing list – but aside from their platform requirements there are very few gotchas to worry about.

That's why, while social media and influencers may be on the rise, email is going from strength to strength. Analyst Statista predicts that email marketing revenue will hit \$12.3 billion worldwide this year, and reach \$17.9 billion by 2027.

## ■ Sign up with an ESP

If you want to use email for marketing, you'll probably need to sign up with a specialist partner. Regular business email services aren't designed for mass mailings; if you blast out thousands of messages to customers and subscribers you could be sanctioned.

Work with an email service provider (ESP) and you'll benefit from tailored hardware and software that's designed to handle large volumes of email. Established players such as Mailchimp, Aweber and HubSpot also give you the benefit of a trusted reputation: email providers around the world know that these services have robust policies and measures in place to prevent abuse, so they'll let your messages through to their intended recipients, whereas mass mailshots from unrecognised senders are more likely to be bounced or junked. When choosing an ESP, ask specifically about delivery rates, and look for a provider that can promise close to 100%.



**ABOVE** Email is universal, and one of the most effective marketing tools your business can use

Like web hosts, ESPs typically offer a range of service tiers, where the amount you pay depends on the size of your mailing list. Aweber's Plus tier costs \$20 a month (billed annually) for up to 500 subscribers, \$30 a month for up to 2,500, \$50 a month for up to 5,000 and so on; Mailchimp Standard starts at £16 a month for fewer than 500 subscribers, rising to £36 for up to 1,500, and £48 for up to 2,500.

Many ESPs let you get started for free, with an introductory month or a free tier with limited features. These vary widely between providers; with Mailchimp's free plan, you can send up to 1,000 emails a month, but your contact list can't exceed 500 addresses. Aweber's Free plan also caps your contacts at 500, but you can send up to 3,000 emails in total.

If you're running a small or solo business, you may find that a free plan does all you need, at least in the short term. Before you wed yourself to any provider, however, try exporting both

your contacts and your email archive; this provides reassurance that you can easily migrate between services or refer back to past messages as needed. That applies particularly if you're trying to build a community around a newsletter, rather than just sending out sales promotions.

Fortunately, the data portability requirements of GDPR and similar regulations mean the process is usually quite simple. For example, Substack is a relatively new player, founded in 2017, but it has some big-name publishers already. If you want to move there from Mailchimp, you simply need to export your Mailchimp audience as a CSV file to Substack and create a campaign archive page in Mailchimp, which you can refer to in the Substack dashboard to complete the import.

### ■ Work within the law

An ESP can also help with compliance. Unless your mailshot recipients are strictly localised to one region, your messages and list management need to comply with a variety of regulations, which is more of a challenge than you might imagine. For example, GDPR and its UK equivalent have been widely discussed in these pages and elsewhere, but what do you know about Australia's Spam Act of 2003, Brazil's Lei Geral de Proteção de Dados Pessoais or Japan's Act on Specified Commercial Transactions?

An email service provider can provide legally compliant sign-up forms to embed on your website, and a watertight mechanism through which recipients can unsubscribe. Ideally, it will also allow you to implement double opt-in, whereby new subscribers receive a link by email that needs to be clicked to confirm their sign-up – protecting them from being signed up for unwanted spam, and ensuring you aren't sending it.

If you're embedding your sign-up form on your own website, be sure to post details of any cookies involved, with instructions on opting out or deleting them. Your data collection and emailing activities will need to be covered in a published privacy policy.

You should also be aware of UK regulations ([tinyurl.com/354ukemail](https://tinyurl.com/354ukemail)) dictating that when you collect a customer's details, you must get additional permission if you want to send them other offers or promotions. Your messages must also indicate who you are, that you're selling something (if, indeed, you are), and any conditions.

### ■ Don't add subscribers without permission

On the subject of sign-ups, it hopefully goes without saying that you should never add individuals to your mailing list without obtaining their active

consent. Be wary of buying in mailing lists: the Information Commissioner's Office (ICO) warns that, when making calls or sending texts or emails, "you can only use [bought-in lists] if all the people on the list have specifically consented to receive that type of message from you. Generic consent covering any third party will not be enough" (see [tinyurl.com/354ic01](https://tinyurl.com/354ic01)).

If you're marketing to other businesses, however, then the rules are different. As the ICO explains: "The PECR [Privacy and Electronic Communications Regulations] rule on direct marketing by electronic mail does not apply to corporate subscribers. For example, this means you can send B2B direct marketing emails or texts to any corporate body. You do not need their consent under PECR to send such messages."

However someone ends up on your mailing list, you should always provide an easy mechanism to unsubscribe – and honour such requests. Doing so doesn't just keep you on the right side of the law, it can be beneficial to your marketing efforts. You won't harm the goodwill you've been building, and you won't be wasting money and resources sending messages to people who don't want to receive them. There's also less chance of recipients reporting your emails as spam – an important point, as too many reports can lead to email hosts blacklisting your material, or automatically categorising it as junk.

### ■ Become a subject expert

We mentioned above that email marketing is a huge business, and that means your audience is probably receiving a considerable volume of promotional messages from all over the web. Your challenge, therefore, is to ensure that they open and engage with your emails.

The obvious approach is to ensure there's something in it for them. If you're announcing new products, advertising a sale or offering a discount, the benefit might seem obvious from your side of the fence.

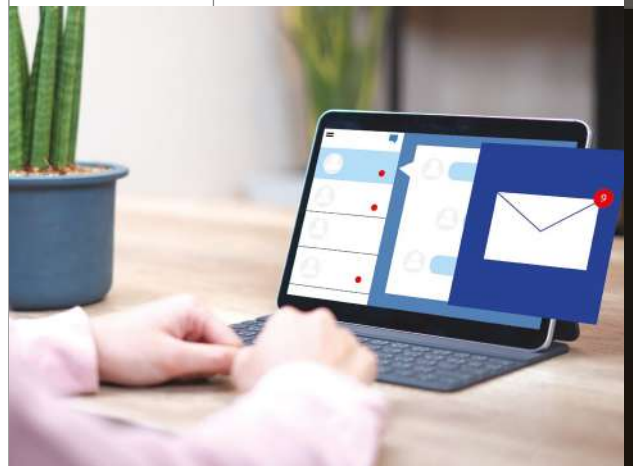
But most of your subscribers probably aren't looking to make an immediate purchase. They might only open such emails once in a blue moon, when they're feeling flush or in need of something specific that you offer.

You have a better chance of attracting your subscribers' attention if you can establish yourself as a subject-matter expert. Even when your email recipients aren't intending to spend money, they'll be engaged by the promise of valuable information.

As an example, the screenshot on the following page demonstrates subscriber growth for a weekly niche-interest newsletter, covering

significant historical events in the local region. The value for the reader is in the content of the newsletter itself, rather than any discounts or product promotions – the list itself has never (yet) been used to directly sell a product or service – while for the publisher, the goal is to drive traffic to an associated website. As the number of subscribers has grown, the newsletter has maintained healthy levels of engagement, with open rates that are almost always over 60%.

Indeed, the newsletter's content reaches a far wider audience than the subscriber base would suggest. Thanks to readers forwarding and sharing content, the 16 December issue actually reached almost twice as many readers as there were



**ABOVE** It's a challenge to get recipients to open and engage with your messages

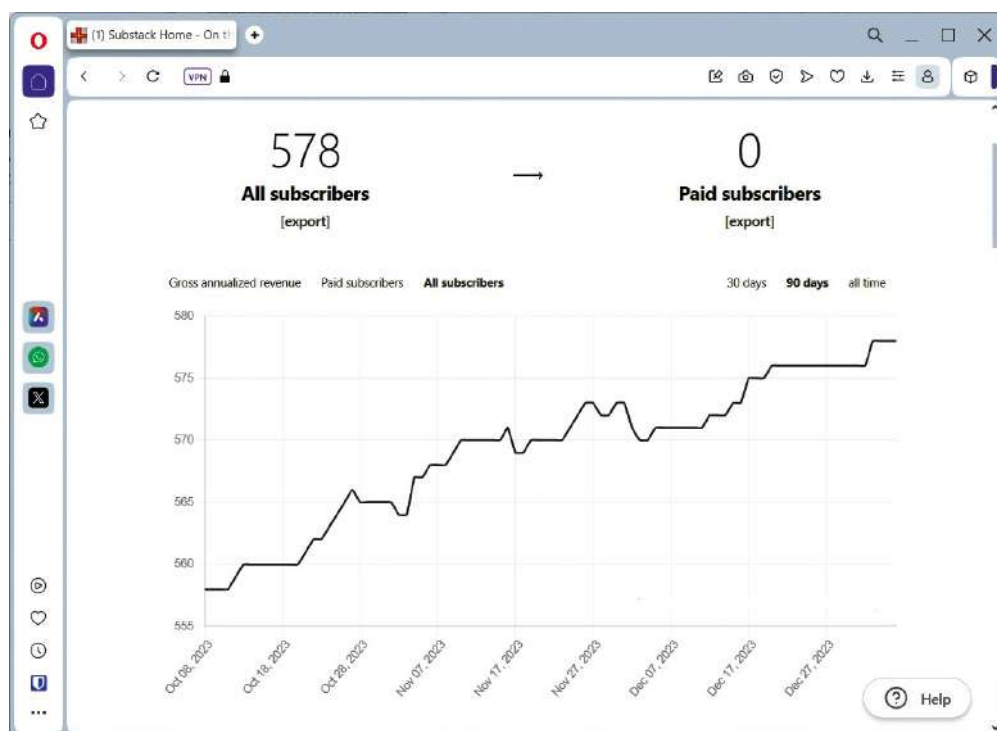
subscribers on the list. One summer issue reached three times as many readers as it was originally sent to.

Access to this sort of information is another benefit of signing up with an ESP. The precise range of metrics available will depend on the platform, and in some cases on the tier to which you sign up. Mailchimp's Standard and Premium tiers go beyond basic metrics to explore customer lifetime value, purchase likelihood and inferred demographics. Similarly, while Aweber's Lite plan includes message analytics, the Plus and Unlimited tiers roll in advanced reporting and analytics.

Even if you don't pay for a service, look for audience tracking, showing your subscription numbers and how many of your emails are opened. Many providers rank your audience so you can see who most reliably opens your messages; these will be your most engaged subscribers, whom you may want to target with exclusive offers or additional content, as we'll discuss later.







## Set and monitor targets

Taken on their own terms the newsletter figures above are very positive, but whether or not you want to emulate them will depend on your specific goals. If you're trying to grow sales, readership numbers alone are no measure of success.

That's why it's important to set clear targets at the outset, and gauge your marketing programme's results against those metrics over time. Once you can see what effect your activities are having, you can tweak the formula. Two powerful tools in your outbox are A/B testing and segmentation. The former lets you try out different approaches to see which is most effective, while the latter allows you to tailor content to different subgroups within your subscriber list.

With A/B testing you produce two versions of a campaign and send each to a subset of subscribers. The difference between the messages could be no more than a different subject line, but you can also use A/B testing to try out different layouts or running orders – or entirely different offers. The key is to see which contributes most effectively towards achieving your goal when it lands in your guinea pigs' inboxes. Then, send that version to the remainder of your list.

A/B testing usually requires a paid account with your ESP. It's included in Mailchimp's Essentials plan (£10.33/mth) and above; Zoho Campaigns offers it in the Standard (£2.40/mth) tier; while Aweber (which calls it "email split testing") offers it in the Lite package (\$12.50/mth) and above.

**ABOVE** This niche email newsletter is enjoying healthy long-term growth

**"Don't save your call to action for the end of the email – many subscribers won't read that far"**

Segmentation works similarly, but it's not intended for trying things out. Rather, it's about tailoring content for different segments of your mailing list. It's up to you to work out how to divide up your readership: if you publish sign-up forms on several external sites, you could start by tagging subscribers based on source, or you could survey them directly to find out their interests. Alternatively, you could play a longer game of iterative A/B testing to discover what sort of emails different people actually open.

You'll also need to decide just how finely you want to segment your address book. It may be tempting to define a large number of small groups for precise targeting, but this can be fiddly and resource-intensive. It can also make it difficult to gauge assess your outcomes: Adobe's cloud team advises that "you do want statistically meaningful segments... so try to avoid segmenting so much that you're left with just a handful of people in each segment" (see [tinyurl.com/354adobe](https://tinyurl.com/354adobe)).

## Don't forget your call to action

You probably know what you want your subscribers to do when they've finished reading your email, but it might not be obvious to them. Don't be shy about signing off with an unambiguous call to action. This could be an invitation to buy something, to make an inquiry, or to forward your email to their own contacts. If you have nothing to push at that particular moment, perhaps

invite discussion by posing a question – and always include a link to your online store or social channels.

Don't save your call to action for the end of the email, either – many subscribers won't read that far. If you publish a newsletter via Substack, the editor will check that you've added subscription buttons – and if you haven't, it will offer to add them itself. These will appear twice in the resulting email: around two paragraphs into your content, and again in the footer. These buttons are dynamic, so people who've already subscribed will instead see an inducement to switch to a paid subscription.

There's an art to writing a concise yet effective call to action. Think about what would make you respond in a similar situation: you can play on people's fear of missing out by promoting a short-term offer, or create a sense of scarcity with a capped deal available to only (say) the first 50 customers. Don't make subscribers feel exploited, though. Offer something of real value, and be honest about its availability or you risk damaging the reputation that your marketing programme should be developing.

This is another situation where A/B testing and segmentation can be effective, allowing you to test the most engaging calls to action, and to vary your offer based on what you know about your subscribers.

## The road ahead

Perhaps the biggest recurrent challenge in email marketing is generating a never-ending series of interesting and engaging messages. This is an area where many businesses are increasingly drawing on AI: as well as creating new body text, AI tools can help marketing teams to repurpose existing content for the platform, or compile curated lists of content with which to engage defined audience segments.

It's hard to predict what other technologies may come into play in the future, but one thing is for sure: as Salesforce says in its latest State of Marketing report, "when it comes to sheer volume of sends, email remains an effective digital channel... in fact, customers say that email is among their preferred channels to interact with brands" (see [tinyurl.com/354salesforce](https://tinyurl.com/354salesforce)). So, old-fashioned as it may seem, don't think of email marketing as an idea that's on its way out: if you're not already using it, it's high time you started. ●



# What is FinOps?

Steve Cassidy finds out how the traditional accounting department can benefit from modern tech methodologies

## FinOps? Sounds fishy.

Very witty. In fact, FinOps most commonly refers to accounting functions making use of cloud services and platforms – so it's one place where you definitely *don't* want any fishy business. The name is, of course, an awkward construction chopped out of “finance” and “operations”, and derives its meaning from the existing context of DevOps. This, you will recall, refers to writing your own custom orchestration code to drive your hybrid server assets.

## So with FinOps we write our own custom accounting code? That sounds risky.

Don't worry, it's not really a direct equivalent to DevOps. FinOps is less about developers, and more about bringing modern IT practices and functions to the realm of finance – so you can sweep away esoteric processes that may have evolved over years and decades, and replace them with speedy, rule-based automations.

## Is it basically about moving our finances into the cloud, then?

I did mention the cloud above, but that's not a necessary part of it. You could have a whole FinOps portfolio

of projects, without spending a single penny on cloud services. The key idea is really automation, and that can take place anywhere. In fact, one of the most troublesome things about pure finance departments is often where they choose to keep their data: just when you think you've justified a total cloud architecture, up they pop with demands for local infrastructure and specialist hosted services. To be fair, they're focused on fundamental accounting issues, such as keeping an eye on reporting and retaining control of the cashflow, rather than month-to-month efficiencies.

## Now, eventually – and never

FinOps isn't a single product you can roll out. It's an ongoing philosophy that drives upgrades and refinements to your finance functions.

To make it a bit more manageable, the FinOps Foundation breaks the idea into three phases, dubbed “Inform, Optimise and Operate”. The first phase involves analysis of potential gains; then comes tuning processes and resources to get the best results. Finally, the Operate phase entails continuous monitoring and validation, to check that your FinOps model is still serving the business.

Any financial task can proceed individually through these phases at its own pace. If that sounds like a lot to manage, you might find it helpful to divide up your activities into the classic three computer-science categories – that is, what's computable now, what will be computable eventually, and what's never going to be computed. This may sound facetious, but some tasks can be mathematically proven to reside in the third category, and that means you can leave them to one side and focus on what can be realistically achieved.

## This sounds like a simple idea – why does it need a dedicated FinOps Foundation to promote it?

Finance is a formidable institution. Its practitioners have numerous professional bodies, colleges, academic qualifications, letters after their names – the whole thing. In the face of such an impressive corps, IT teams may feel rather underpowered to promote innovation. The FinOps Foundation ([finops.org](https://finops.org)) is there to provide practical and informational support, along with evidence of how technology can deliver strong oversight and – in all likelihood – better reporting than the humans can currently fit into the working day.

## Are the potential benefits really that big?

Bill Gates once observed that people overestimate the initial impact of technologies, and underestimate the longer-term effects. In the short term, there's definitely a limit to how much accounting and financial management can, or should, be delegated to machines: warring AIs are blamed for at least one of the last four recessions. But if you look forward ten or 20 years, it's impossible to imagine that successful companies won't be exploiting advances in automation and AI to make their finance functions smarter and more efficient.

## Is AI really necessary? Aren't we just putting together balance sheets here?

If your business is that simple then I'm quite jealous. It's hard to achieve the level of security demanded by most money-moving bodies in Excel. In most cases you'll need something more – for example, code that looks at your rules and requests, and tries to output them as a set of connections to third-party services, some check-and-balance work and a private report of any exceptions encountered en route. Of course, if you do have any simple, easily expressed tasks then those are the perfect starting point for your FinOps project. ●



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# Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

## “Having a Wi-Fi infrastructure that allows for multiple SSIDs is a good idea”

**What do you do when your dishwasher stops sending notifications? Simple, fix your wireless network. But an error message on a NAS is a graver cause for concern**

**M**y dishwasher stopped sending me notification emails. I will immediately accept that this is the very definition of a first world problem, and that maybe I should get a life. However, it had been working just fine. To debug the issue, it was important to consider the flow of the information. The dishwasher, a relatively new Bosch item that does excellent cleaning, connects to my home network. It then talks to a cloud service and registers its status there. The app on my phone connects into the cloud service and can then control the dishwasher by a messaging redirect.

The first place to look was obviously the app. I fired it up, and, as I suspected, it couldn't find the dishwasher. Which meant that the dishwasher could no longer connect to the cloud. I examined the DHCP records, got the IP address reservation (based on MAC address) of the dishwasher, and then tried to ping it. No response, so there wasn't an IP-level connection in place.

While on the subject, every regular device on your network, whether this is home or office, should have a MAC-address-based DHCP assignment. That way you can control all IP addresses from one place and group items into logical address spaces.

I know most routers seem to default to 192.168.x.x, and that's fine. Some use a smaller assignment, like 192.168.50.x. That's fine too, but somewhat cramps your ability to divide things up. I like to use 10.101.x.x

and 10.201.x.x, using the first “x” to denote the product type. So 10.101.10.x might be all of the switches on the network, while 10.101.20.x might be the Wi-Fi access points, and so forth. Each group allows me to have 250 or so devices, which is more than enough.

Then there is the whole question of VLANs, which we will return to later on.

Back to my dishwasher. I couldn't ping it, so the IP connection wasn't working, and that meant that it couldn't connect to the Wi-Fi access point. Then I realised that I had made a small change on the previous day.

Grab a coffee, as we now need to dive into Wi-Fi and SSIDs. There is quite a religious viewpoint over SSIDs and which Wi-Fi channels they should use. Many believe that you must have one SSID for the 2.4GHz band and another one for the 5GHz band. A typical naming convention might be MyHouse and MyHouse5. You then connect devices to the SSID that you wish to use, based on your knowledge of the signal strength and quality available wherever you are currently working. If you're fairly nearfield and using an active device such as a laptop, then the 5GHz connection will probably be the faster one. A smaller IoT device, with very



Jon is the MD of an IT consultancy that specialises in testing and deploying kit  
[X @jonhoneyball](#)

**“Many believe you should have one SSID for the 2.4GHz band and another for the 5GHz band”**

**BELOW** Washing the dishes via the cloud was stymied by a network error

little ongoing traffic placed several rooms away, will suffice quite nicely on 2.4GHz. The higher traffic levels, and thus choking, on the 2.4GHz band caused by the signal going further (and hence interference from neighbours) won't matter so much for these devices.

The other view is that you use one SSID for both 2.4GHz and 5GHz, and allow the device, in conjunction with the access points, to decide which one to use at any given time and place. This is called band steering. In essence, the base station knows about the client, and knows whether it has connected on 5GHz before. If it has, and it's trying to connect on 2.4GHz, then it drops the connection and attempts to make the connection on 5GHz.

There are various levels of push that can be applied here. The most normal one is “prefer 5GHz”, where the client has already connected to the access point on 5GHz before, so the access point knows it can work. There is “force 5GHz”, where it knows that the client can connect and forces the issue. Finally, there's a more “balanced” mode where the access point works out how busy the 2.4GHz and 5GHz bands are, and assigns the client to whichever is the quieter of the two.

Now, sometimes this can go wrong, especially with IoT devices. There is a particular class of, and I'm being polite, “low-end” devices that can't cope with a single SSID that's on both 2.4GHz and 5GHz.

In essence, the more grown-up method of shuffling clients around on access points is too much for them. It's a more





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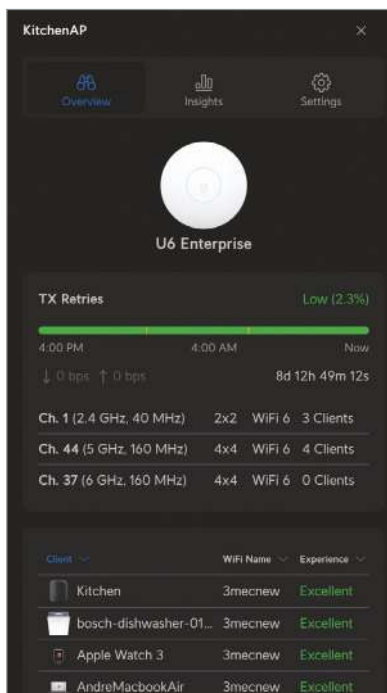
**Davey Winder**

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**Steve Cassidy**

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**ABOVE** The base station in the kitchen is the enterprise-grade Unifi U6 Enterprise device

common limitation than you might expect in 2024 on IoT devices, but is a good indicator of just how low quality many of these devices are.

That's why having a Wi-Fi infrastructure that allows for multiple SSIDs is a good idea. You could set up one called "HomeIoT" and force it to be only on the 2.4GHz band; another for "HomeGeneral" can be on 2.4GHz and 5GHz with band steering; and maybe a further one called "HomeFast" for high-performance devices that really ought to be on the 5GHz band.

However, you'll notice that most Wi-Fi routers, access points and mesh systems don't really allow multiple SSID. You can have the standard one, either in single or split SSID modes,



and another set for guest access. But often that's all that you can do. This is one reason why I prefer more grown-up solutions such as Unifi and Cisco Meraki, which support multiple SSIDs on each radio, and thus allow for proper planning and deployment.

Back to my dishwasher yet again. The base station that's in use in that part of the house is the enterprise-grade Unifi U6 Enterprise device. I'll accept it's total overkill for my needs, but I wanted a device that would do the new 6GHz band, and this was a good option at the time. Unifi claims it will support more than 600 concurrent devices, but even the Honeyball household doesn't have that many IoT devices.

For the 6GHz Wi-Fi band, I had set up a special SSID of 3MECNEW6 (3MEC refers to my house number, NEW because it was a new setup some years ago – and these things tend to lurk about – and 6 for 6GHz). Then yesterday I decided to tidy things up, and enabled the 6GHz support on the 2.4/5GHz 3MECNEW SSID. And that's the point at which my dishwasher stopped working.

It's possible that this is one of those odd compatibility issues that will get ironed out in time. After all, the dishwasher had no problems with

**ABOVE** Success (and clean dishes) at last, but IoT needs to be cleverer than this

**"Bad sectors on a drive are part and parcel of the life of a drive"**

the 3MECNEW SSID being on both 2.4GHz and 5GHz. But adding in support for 6GHz seems to have miffed the appliance. I could fiddle things around, but frankly it was just easier to turn off 6GHz on 3MECNEW and return to the 3MECNEW6 SSID.

Nevertheless, this has reminded me that I really should have a 3MECIoT SSID on just 2.4GHz,

especially for these IoT devices. I might set up a VLAN for it, too, to keep these pesky devices away from the main network, but in the meantime there's beer to be drunk at the pub.

## Fixing a failing NAS disk

It wasn't the sort of email I wanted to receive. "The number of bad sectors has increased on Drive 2 of DS1817+. We recommend running data scrubbing to ensure data consistency. If the number of bad sectors continues to rise, refer to this article for troubleshooting." It then went on to tell me that it's a 12TB Seagate drive, formatted to 10.9TB.

Bad sectors on a drive, whether it's a physical spinning disk or an SSD where a cell goes bad, are part and parcel of the life of a drive. I like reading the drive statistics posted at [backblaze.com](https://backblaze.com), the latest being at [tinyurl.com/354blaze](https://tinyurl.com/354blaze).

Backblaze is a cloud storage and archive company, founded on the principles that you don't need enterprise-grade drives if you design your storage fabric correctly. And, much to the apparent upset of various drive vendors, it publishes its failure rates. The last set of numbers are from Q3 2023, where it had just over a quarter of a million drives in active operation. Of these, Backblaze saw 935 failures, which is an annualised failure rate of about 1.5%. If you look at the historical data, the rate has run between about 0.7% to 2% over the past few years, so 1.5% is not an unexpected value.

You can dig into the numbers and get all the information on each specific drive. Backblaze doesn't have the exact same drive as mine (ST12000VN0007-2GS116), but it does include four different ST12000

## Advantages of VLANs

VLANs allow you to logically split up your physical network by attaching VLAN tags to traffic. So you could have all traffic from one SSID called "HomeIoT" going down a VLAN called "HomeIoT" and it will be on its own IP address range. At your router, this is then shovelled out to the outside world, and it's entirely up to you whether this IOT traffic can have any visibility to the core network or not.

The big advantage here is that if you have a suitably well-designed network fabric, then managing all of this should be extremely straightforward. How much of this you want to implement is entirely up to you, but it's worth knowing it's there. And remember, all VLAN traffic goes over the same physical network, even though it's logically divided up.





drives in its statistics, the vast majority being the ST12000NM001G and ST12000NM0008. Their failure rates on there are 1.3% and 3.4%. So these things die.

Now, the drives in this particular Synology NAS aren't exactly box fresh. They've been running for years; this particular drive has a "power on time" of 45,094 hours, which is 1,879 days or just over five years. My trusty Synology DS1817+ box includes eight drive bays, with an upgraded 16GB of RAM (of which about 8% is in regular use). A 10Gb Ethernet card improves on the built-in standard 1Gb ports.

This isn't a primary server: it's a backup server on the network. By that, I mean we have a primary server that everyone connects to and on which all data is stored. I then use the excellent file system snapshotting capabilities both to create snapshots on the primary server and to replicate file system shares to other servers, where they exist in a live-updating but read-only form. If the primary server were to die, the backup servers would have a near real-time copy of the data, and could be switched into being a primary server.

I could do this with the real-time fail-over capabilities, but that's overkill for my needs. Having multiple snapshot replications to backup servers, both on-premises and off-premises (but still on-LAN) gives me some reassurance against hardware failure of the primary NAS. I also use the Synology HyperBackup tool on the primary server to send backups in backup format to secondary servers – this particular server is also a HyperBackup Vault

server, acting as a repository for incoming backup streams. Then on the primary server there are a bunch of other backup and archiving capabilities in place, including multiple cloud destinations. But that's for another time.

Having been told that my disk was suffering, it seemed sensible to go into the settings to see what was happening. The tool for this is Storage Manager. In here, I could see that the eight drives had been set up as a single large volume, using the Synology Hybrid Array file system format. This is like a RAID arrangement, so you need *N* disks plus one to spread a fault-tolerant array across. In other words, if you have six disks in the array, you need a seventh for the calculated parity data. It isn't all stuffed on just the seventh, but spread around all the drives in the array.

I had set this up to allow for one disk failure. I could have configured it to allow for two disk failures, but since it would be a destination server for backup and archive, rather than a live production server, I was happy with the reassurance of a single drive failure. But in retrospect that wasn't enough. If you lose a drive in this array, then you need to put in a replacement and kick off a rebuild. This rebuild can take quite a long time; one measured in days rather than hours. This is where the two-disk failure mode is useful: it would be quite annoying if you had a failure, kicked off a rebuild, and a second drive failed during the rebuild time. At this point, your array and the data it contains would be toast. With the second disk failure protection, you could have replaced the first failed drive,

started a rebuild, and then coped with a second failure. It's all about risk profile, balancing available storage versus robustness.

So how best to handle a drive failure? The best solution is to have a hot-spare in the array already. This is a drive that's ready to be pushed into service but is idling and not storing data. When one disk in the array fails, the system can automatically start rebuilding the array using the hot-spare disk. This can save a lot of time, especially if the array fails at beer-o'clock on a Friday evening. The array might be nearly rebuilt for 9am Monday morning, and you wouldn't have needed to lift a finger.

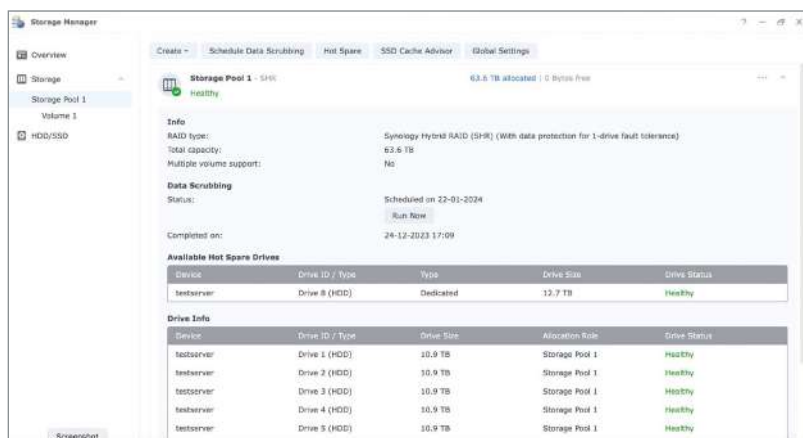
All of this is good stuff. But what was happening with my disk? I used the Data Scrubbing feature in Storage Manager to force the array to check itself. In doing this, every piece of data is read and compared to its checksum. If something is wrong, then it can be flagged. This task takes quite some time, because it runs in the background and doesn't overwhelm the primary file system service capabilities.

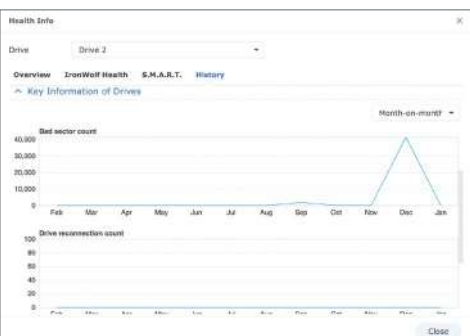
When it was done, it gave a clean bill of health. So everything was okay at the file level. Let's now dig deeper into the drive itself, which is Drive 2 in the NAS. Selecting this, and then choosing Health Info, brings up the screen about what's going on with this drive. I started with the basic health data: it said it was Healthy. Which is a little odd, because the NAS had emailed me to say there were issues. Maybe this meant there were issues but they weren't fatal yet? Because this is an IronWolf drive, and Synology NAS supports extra health data from this brand, I checked the IronWolf data. This was fine, too. It was time to move over to SMART data, which is the low-level protocol by which drives can report what's happening.

**ABOVE** The drives in my Synology NAS have been running for many years

**"The rebuild can take quite a long time; one measured in days rather than hours"**

**BELOW** Synology's Storage Manager wasn't much help, suggesting the faulty disk was healthy





**ABOVE** The problematic hard disk appears to be well again, but only time will tell

I first ran a SMART Quick Test, which came back clean. Then a SMART Extended Test which takes many hours. Again, it came back clean.

However, my interest was piqued. On the History tab, I scrolled down and looked at the bad sector count. Up to August, it had been a count of zero bad sectors. In September it went up to 1,856. In October it was back to 24, and November down to zero again. It looked like some automatic patching was going on within the drive, mapping out these bad sectors. But then in December it had leapt to 41,352 bad sectors.

I looked for the deep SMART data from the drive itself, looking for all the nerdy stats on bad sectors and remapped errors. But it had gone. It seems that since Synology Update 7.2.1-69057, the deep SMART data is no longer reported. It's either Healthy or Bad. Dear Synology, kindly put it back, please.

What should I do? Well, this is an endpoint server for backups and snapshots. And in that role, it's one of a number of servers. You wouldn't build a NAS infrastructure with just one NAS, and this is why. If the drive actually implodes and goes offline there's a hot spare ready for an immediate rebuild. So for the moment, I am leaving things be. I will rerun the Data Scrubbing and extended SMART testing every two weeks, and will see what transpires. It might continue to get worse. Or stabilise. But having done an appropriate risk analysis of the NAS, its functional use case, and the capabilities built into the NAS itself with the hot spare, I think it's okay to leave alone for the time being.

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LEE GRANT

## "In two decades, I have only ever found five faulty CPUs. Was this faulty CPU #6?"

The tears flow as a celebratory cake is slapped away by a fault that never happens. Plus: how many security products can be bought by accident?

Last December, our computer repair shop almost celebrated 20 years of business. We don't get excited about anniversaries, but two decades seemed cake-worthy – until fate served a helping of humble pie instead. I've previously written about the shadowy spectre of Hubris that hides within each repair, ready to slap down techies who believe (if only for a second) that they're mastering the art of fixing. During the week of our anniversary, Hubris arrived three times to run amok. I'll save two of the tales for a rainy day and leave you with this. If you want me, I'll be the one in the corner, crying.

Mark's PC was a desktop built by an online retailer a few years ago. They moulded it around a ninth-generation Core i5 (Christopher Ecclestone) and an MSI H310 motherboard sporting 32GB of RAM. Mark reported two issues. The first was that a certain game, the name of which is unimportant, crashed the machine. The second problem was that his recent purchases of RGB case LEDs and a spangly new LED rear fan wouldn't light up.

Neither problem seemed serious, but of the two, the crashing game was the more troublesome. When diagnosing potential gaming issues, I avoid (if possible) using the client's own accounts as I don't want to



Lee Grant and his wife have run a repair shop in West Yorkshire for over 20 years  
X @userfriendlypc

"During the week of our anniversary, Hubris arrived three times to run amok"

**BELOW** A particular game was crashing Mark's machine – but why?

mangle their hard-earned scores or online reputation. Initially, I ignore software and focus on hardware. The prime suspects would be GPU, RAM, PSU and thermals, but it's critical to keep an open mind as the evidence may point to other areas. What made Mark's desktop tough to diagnose was that it wouldn't start.

Mark hadn't mentioned this, so I made the presumption that a power connector had popped off during transport. It hadn't. A precautionary re-seat of RAM (another show-stopping dislodgeable) didn't help. Mark said that the machine had worked the previous day so clearly something had gone catastrophically wrong between his shutdown and my startup. Parking the gaming problem, I removed the SSDs for testing – mercifully they were alive – then placed them to one side. The machine also wouldn't start when connected to our test PSU, so for good measure, I tested Mark's PSU with Dr Power 2 ([tinyurl.com/354drpower](http://tinyurl.com/354drpower)). It's an old tool for checking voltage basics and much easier than jabbing multi-meter probes into suspect sockets. Mark's PSU received the all-clear from the good Doctor.

I've yet to mention Mark's CPU cooler, a MasterLiquid ML120L V2 RGB AIO by Cooler Master. Its radiator and fan combo were hindering the access to the board, and only when it was removed did I spot two red lights on the MSI's EZ debug LEDs. This was a good omen as it shows the board was trying to tell me something about RAM. From the toolbox I attached a mini-plug speaker ([tinyurl.com/354miniplug](http://tinyurl.com/354miniplug)) and listened as the board sang a beepy song of RAM failure. Feeling positive, I pulled Mark's RAM, plugged in a test stick of DDR4 and foolishly awaited the POST beep of success. My test RAM still beeped and the red EZ LEDs continued to twinkle. The same happened when I







swapped in a test GPU (as expected, but I had to be sure), so by a process of elimination, I could tell Mark that his motherboard had died. I'll quickly mention the CPU for the sake of completeness, but as CPUs don't go wrong, we'll move on.

## Board yet?

Although Mark's Core i5 was a 2019 product, it used the Coffee Lake variation of Intel's socket 1151 motherboard, and full marks to you if you can find a new one for prices that won't bankrupt a small Yorkshire computer shop. Alison sourced a replacement, which we'd been assured was new, but clearly wasn't. At this point, we were still in a diagnostic phase, so the costs of acquiring the board (and the labour) were all ours. As the clock was ticking, I took the "newsed" board and bolted Mark's components into it. Still it beeped. I began swapping his parts for test components (even our test PSU re-appeared) and the beeping persisted. I cursed the newsed board for obviously being garbage when I realised that beneath the nest of temporary parts and cables strewn across the bench was only one of Mark's components, the CPU, but it couldn't be that as CPUs don't go wrong, do they?

In two decades, I have only ever found five faulty CPUs. The binning process used by manufacturers means CPUs are robust components, so was this faulty CPU #6? Was the newsed board trash? Was it both? The beauty of having a repair shop is that I've squirrelled away used components to use as test units, but annoyingly I didn't have a Coffee Lake 1151 CPU available. A Celeron G4930 arrived several days later, which enticed a single POST beep from the newsed board before bringing the display to life. I scanned the car crash of Mark's parts, test parts and purchased parts littering my workbench, feeling as professional as Charlie Croker dangling over a cliff trying to reassure everyone with: "Hang on a minute,



lads. I've got a great idea."

Before I could speak to Mark, I needed to test his components with the new CPU, but as I'd gutted this entire (heavily cabled) machine, it took an unpleasantly long time to resolve, especially his LED problem. Mark had inadvertently bought three different standards of LED lighting. There was the 3-pin ARGB, which runs off 5V, 4-pin RGB (12V), and the new Corsair iCue fan wanted between 6V and 13V depending on setup. None of them is interchangeable.

Inside Rob's case was a Cooler Master RGB generator, which produced the RGB signal for the cooler's CPU hub and radiator fans. Mark's new RGB LED strips worked well with it, but the Cooler Master RGB generator is lights only, no fan power. That functionality came from an unbranded ARGB combi-box with multiple fan headers, but as we didn't have any ARGB fans, this box was for muscle. Finally, the Corsair iCue uses a proprietary connector (why?) and, although it's possible to buy an iCue to ARGB connector, we didn't have one, so the Mark's iCue fan spins (driven by the ARGB combi-box) but the lights are off. Obviously, I didn't test the game as his PC was running a Celeron rather than an i5, but at least I could make a call to confirm that his CPU had died. Well done to you if you predicted this at the beginning. Somehow, Mark's story isn't over, but to save us all from more trauma, I'm going to speed it up.

As with the motherboard, finding a

new Coffee Lake CPU is extremely tough, but Mark enthused about trawling eBay for a bargain refurbished i5 or i7. Cunningly, I'd re-wired his MasterLiquid RGB AIO cooler so I wouldn't have to rebuild the infernal machine for a second time to swap a replacement. An hour later, Mark mentioned that he'd been thinking of an upgrade for a little

while and instructed me to fit a new motherboard, CPU and SSD. As I took the snips to my carefully cable-tied creation, a tear rolled down my cheek and I noticed that Hubris had fingered the word "tawt" in the layer of dirt on the shop's window.

The new kit arrived. An Intel i7-12700F (a Capaldi, which was fitting for the language being sprayed around the shop) inside an ASRock B660M motherboard. I chose this board as it would accept Mark's DDR4, it has both ARGB and RGB headers and, with a BIOS update, it will accept 14th gen Intel chips (known as the Tennant\_Agains).

Imagine a fast-paced montage where I pull Mark's old, dusty components and fit gleaming replacements throbbing with newness and success. We'll fast-forward through the bit where I have to ditch Mark's MasterLiquid RGB AIO CPU cooler as his previous vendor hadn't supplied the Socket 1700 mount for it (I used the stock Intel), whiz past me re-jigging all the lighting for the third time in as many days, then slow for the crescendo as I hit the power button and absolutely nothing happens. After more fiddling, I worked out that Mark's RAM was the fault.

At this point, I'd had enough of the damn thing and don't mind admitting that I'd been hitting the coffee and Hobnobs with an unhealthy rapidity, propelling myself down the self-destructive road to hyperglycaemic oblivion.

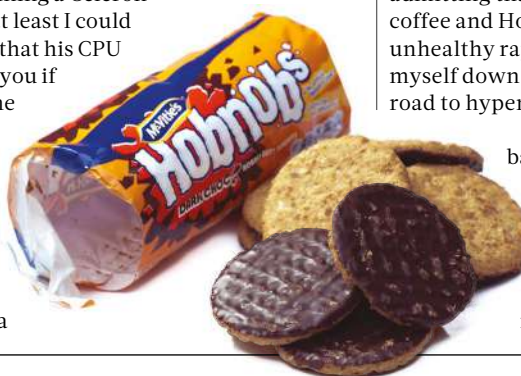
But something in the back of my brain made me realise that the B660M motherboard was only serving 1.2V on the RAM sockets, and Mark's older DDR4 needed 1.35V. Using my

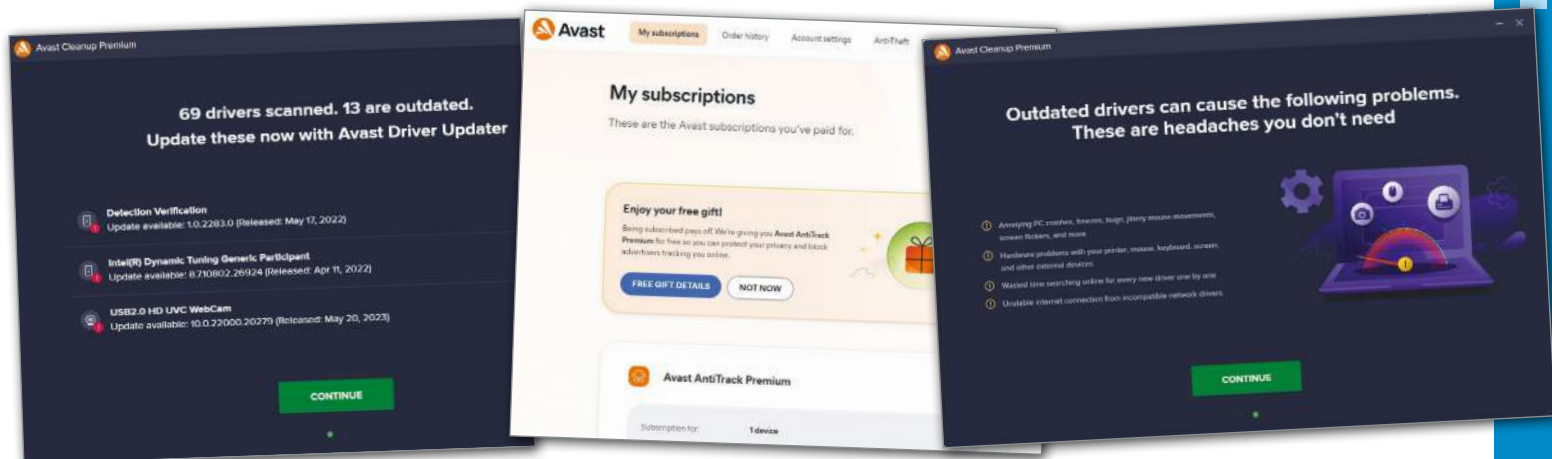
**ABOVE** The PC was reduced to its bare bones after being stripped down

**LEFT** Choose your LED connector wisely

**"As I took the snips to my cable-tied creation, a tear rolled down my cheek"**

**BELOW** Too many Hobnobs can lead to memory failures





faithful DDR4 test stick, I could manually tweak the BIOS, then swap in Mark's DIMMs and, finally, the bloody thing finally powered up.

I cloned his boot SATA SSD to the new M.2 SSD, but something remained awry as Windows wouldn't boot. I genuinely can't tell you what happened next. David Bowie would retell that heavy cocaine use prevented him from recalling the recording sessions of his fabulous *Station to Station* ([tinyurl.com/354bowie](https://tinyurl.com/354bowie)) album, and due to the intoxicating effects of copious amounts of caffeine and multiple packets of chocolate-covered biscuits, I truly have no memory of how I resolved this boot problem, but I did.

Finally, I stuck the RGB LEDs around the front of the case and bolted the whole thing back together. Although it was past 9pm, I called Mark and, less than 15 minutes later, I was showing him around his rebuild with the clarity of a half-naked drunk man trying to appear sober despite being surrounded by empty lager cans and standing in a pool of liquid that definitely isn't lager.

Two weeks later, I received an email from Mark. "A massive thank you is in need for all your help! Everything with my PC is working very well. Very pleased with it! Much faster and running games far better than I expected!" Despite the cruel machinations of Fate, Luck and Hubris, Mark clearly has a smile on his face. Looking somewhat more glum is our accountant because an analysis of the financials reveal that even if we disregard the hours of labour, when we balance the hardware costs of the unused i151 board and the Celeron and the profit made on the i7, 1200 board and M.2 SSD, the job made a bumper pre-tax profit of just under £20. I asked Mark if I could include the story of his recalcitrant machine in *PC Pro* as CPU failures are such

a rare thing. His response: "Hi Dave, yes that is absolutely fine!" Dave? Pass me the biscuits...

## Avast profit

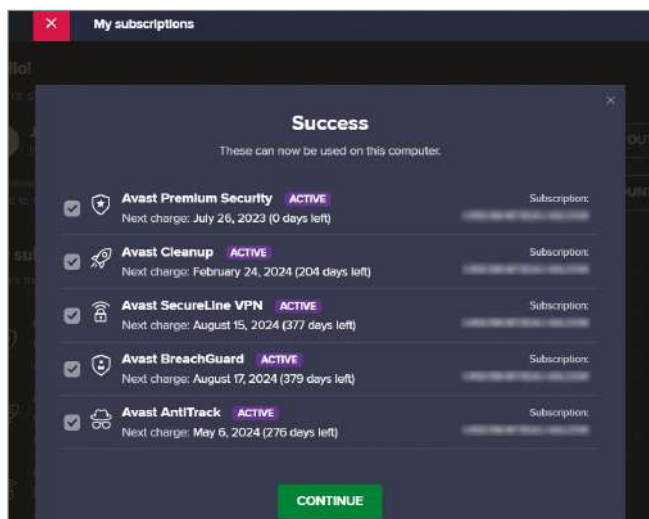
How much are you paying for internet security? Do yourself a favour and check. It's a task worth repeating with family members as recently we've encountered a few customers paying far more than they realised. The most eye-opening incident was Julia, a wonderful lady in her 80s who preferred an analogue life but was forced to tackle technology when her tech-loving husband passed away.

Julia was concerned about subscription messages that her Avast installation was throwing up. She was certain that she'd paid and it didn't take long to discover that she had. Many, many times. She'd bought Avast Premium Security for a pleasing £23.88 but, this being the modern era, where taking out a subscription seems to give vendors the green light to bombard loyal customers with nagging upsell offers, it wasn't the only package installed on the machine. There was Avast AntiTrack Premium, Avast CleanUp Premium and Avast SecureLine VPN, which totted up to a staggering £157.51. The issue was that despite having a large

**ABOVE** Julia had unwittingly taken up a vast number of Avast subscriptions

**"As Avast's advert states, 'Being subscribed pays off' – for whom is unclear"**

**BELOW** Check your subscriptions to make sure you're not shelling out unnecessarily



haul of subscriptions, Avast persists in launching ads masquerading as warnings that dark forces were tracking every click. Julia misunderstood the messaging, presumed her inexperience meant the online payment for her AV subscription had failed, and tried again.

Her payment history revealed she'd also bought Avast BreachGuard, which Avast helpfully flagged as being unused on any system. Total bill now £198.07. I don't want you thinking Avast is ungenerous to its customers. Julia's account displayed an advert offering her a free copy of Avast AntiTrack Premium, curiously placed above the subscription information for the same product for which she'd already paid £25. As Avast's advert states, "Being subscribed pays off" – for whom is unclear.

Those familiar with Avast's range may have spotted that Julia had somehow missed out on Avast Driver Update, which the company promotes as a fix for crashes and slow browsing. Experience has shown me that slow browsing due to out-of-date drivers is a much rarer occurrence than a machine bogged down with unwanted software accidentally installed by an inexperienced user.

Let me be very clear by saying that Avast has done nothing wrong. It has made an offer to a customer which has been (albeit unwittingly) accepted. Julia didn't contact Avast for advice as she genuinely didn't know what was happening. Although her annual Avast bill was almost £200, it was split into much smaller chunks across the year via credit cards and PayPal, making the real total hard to spot. On her instruction, we terminated all of Julia's renewals, cancelled her payments and removed all the Avast products from her PC. Her browsing has never been speedier. Take a moment to review your own subscriptions, especially if you've been auto-renewing for a few years. You may be paying more than you think.

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ROIS NITHUAMA

## “The part of town I find myself in is considered by locals to be unsafe, but I don’t know this yet”

**Some claim that the EU’s forthcoming AI law could kill innovation. In truth, a lack of protection means it’s more likely that AI – or an app – will kill us**

Last year an app tried to kill me. Twice. That isn’t hyperbole. The unnerving anecdotes that follow take on new relevance as the EU looks set to introduce the world’s first comprehensive AI law. Some commentators have implied that regulating AI is the slow strangulation of innovation, stifling creativity, smothering efficiency and suffocating entrepreneurs. Now that is hyperbole.

Whatever firms do, whatever sector they’re in, they must meet their legal obligations. No matter what tool they created, whether it’s powered by AI, ML or fairy dust, that business can’t escape or evade liabilities. The two instances that I set out are instructive as they provide colour and clarity to the “new” rules.

In the first scenario, this travel app sent me to a town five miles west of Davos. Sounds good. After all, I was due to attend an event on behalf of a firm that I was doing some work for. The firm provided the app along with instructions for use. Its use was non-negotiable. The benefits, or so the firm claimed, included speedy and efficient booking as well as expense management.

The event was scheduled to coincide with the time of the year when every world leader and policy wonk descends on this otherwise quaint skiing town nestled in the Swiss mountains.

Being able to use a travel app that had AI built in so that the tool could do the heavy lifting on the search function to find a hotel close to the town at that busy time was considered a big win. A hotel room, reasonably priced, near Davos in January at the same time as the World Economic Forum, looked like a proof of concept. Excellent; what could possibly go wrong?



Rois Ni Thuama is a consultant and expert in risk mitigation and cyber-governance. [X @rois\\_cyberstuff](#)

**“The hotel was indeed five miles from Davos – but only as the crow flies”**

I struck out from Zurich airport for the hotel in weather that was predictably atrocious. The route to the hotel is along a narrow mountain pass, which as a driver will keep your attention as you survey the sheer drop. Gulp.

Not to worry. By taking it steady in the hire car with its winter tyres, the benefit of getting to a hotel that promised to be a short drive to Davos seemed like a reasonable trade-off.

But when supposedly driving to the hotel it was impossible to ignore that while it was the end of the road for me that day, it was also the end of the road. Literally. There was no more road. And I hadn’t passed Davos. So where was it? The hotel was indeed five miles from Davos – but, it turns out, only as the crow flies. Do crow’s use apps? I don’t believe they do.

The only way to make this journey five miles would have been to hike 2,843 metres up Weissfluh and then para-ski down the other side à la James Bond. I sent a message to the team in London, who picked it up the following day, then contacted the travel firm and made alternative arrangements for the night. The next

day I drove the full 50 miles by road to Davos back along the treacherous mountain pass to attend the event and get to work.

I was somewhat sanguine about this misadventure. The travel app was new, and whoever had introduced it into this business couldn’t have known its pitfalls. Would a trip to Davos in January have been conceivable at the point that the company entered into the contract with the travel app provider, and could it create a danger? I don’t believe that to be the case. Crucially, that’s a solid defence for a firm. Would it have been in the contemplation of a reasonable director that the travel app could create a perilous situation endangering a worker? Not at the time of entering into a contract, no. But when stuff happens and new insights are made available, reasonable people course-correct.

### Luck is not a strategy

Which brings me to the second and much less amusing tale relating to the use of the same travel app.

This time it’s a balmy night in Washington, DC. After a transatlantic flight, a long and arguably unnecessary delay at JFK, I find myself locked out of a hotel after midnight on DC’s mean streets. Mean streets isn’t just a turn of phrase to court controversy in a column. A murder map of the US Deadliest Cities – compiled with reference to statistics from the FBI, the US Census Bureau and police officials – puts DC just outside of the top ten. The part of town I find myself in is broadly considered by locals to be unsafe, but I don’t know this yet. What I do know



**RIGHT** Travel apps could land you far from your intended destination

is that it's after midnight, that the hotel has no reception desk, and I have no way to get in.

I'm just about to learn a new and important piece of information. Turning this time to the travel companies 24-hour helpline I learn... there is no helpline. Dun dun duuun.

Standing in the shadows, a tall, heavily tattooed stranger smoked a cigarette. You know, one of those that we all smoked more than a quarter of a century ago behind school bike sheds, long before vaping was a thing. He asked if I had downloaded the app. I reviewed the "Check in" details I'd been sent: no recommendation or suggestion to download an app, no PIN code to get in, no notification that the hotel has no reception staff. And no helpline. Wonderful.

He used his app to contact the hotel. The hotel helpline took his call because he was already checked in. Yes, they could see my name on the guest list. Could I give them the PIN? No, I couldn't. Could they let me in? No, they couldn't. They needed the PIN. A PIN I didn't have. We did this dance for about two hours. The hotel relented, recognising they owed me a duty of care and let me in. Finally, after a 24-hour day spent travelling, waiting and arguing outside a hotel in the small hours, I could collapse onto my hotel bed.

These two instances illustrate why this regulation is necessary. When management is unaware of a danger that a tool creates, it is not reasonable to expect them to take preventative action. Preventing what?

When management learns that a tool it insists on deploying poses genuine risks, and after receiving new information, collectively refuses to take action, prioritising the efficiency of an expense system over the safety and well-being of its staff or customers, it's clear that regulatory oversight is essential.

## Nothing new under the sun

The EU's objective is to make sure that AI tools are safe, transparent, traceable, non-discriminatory and environmentally friendly. These obligations already exist for a plethora of other tools, so the "new" rules should be uncontroversial.

The new rules categorise risks across four levels: unacceptable, high, moderate and low to no risk. "Unacceptable", as the title suggests, means that the AI tool is banned. An example you may recognise is the outrageous claim made by some AI grifters that their tool can read micro

expressions. I know. Pause to eyeroll. And further that these micro expressions are capable of revealing a person's worth as if the number of times someone blinks reveals anything more than dry eyes. If you know of such a tool, consider it banned and put it in the bin.

The "high" risk category relates to tools that negatively affect safety. Bearing in mind Parliament's priorities to ensure that AI tools are also transparent and non-discriminatory, let's consider the DC incident and the data points that the platform had access to. The traveller is: one, female; two, travelling alone; three, on a transatlantic flight with (four) a stopover of several hours in New York; which means, five, the second hop gets into Reagan at close to midnight (local time).

Any tool worth its recurring fee should be able to (i) calculate the length of that working day; (ii) offer a filter to omit hotels that require a PIN code; and (iii) ensure that a human

**ABOVE** The mean streets of Washington are no place to be alone after midnight

**"It's after midnight, the hotel has no reception desk, and I have no way to get in"**

**BELOW** An earlier Supreme Court judgement also applies to AI tools

greets the traveller so that he or she is accounted for.

The new rules will mean that "AI systems should be overseen by people, rather than by automation, to prevent harmful outcomes". It takes little imagination to conjure up an unhappy ending to the DC business trip.

Approaching that requirement to convert it into a practical business function would compel a firm to nominate an individual to be accountable for how the tool operates and whether it aligns with existing obligations.

To ensure that no manager gets to mark their own homework and to avoid a conflict of interest, businesses should separate the functions of onboarding the tool from the oversight of the tool.

The EU may be first to conceive of the pitfalls of AI, but it won't be the last. Ten years ago, in a case relating to the provision of technology and equipment, Lord Hope delivered the leading judgement for the Supreme Court of the United

Kingdom. He wrote: "The law will always attach importance to the protection of life and physical safety" ([tinyurl.com/354judgement](https://www.tinyurl.com/354judgement)). The judgement does not go on to make exceptions for AI tools, and therefore the law in the UK is clear.

The mystery is not that AI tools fall within the scope of existing legal obligations. What is bewildering is that executives have failed to appreciate that their obligations to ensure that tools do not pose significant risks to the health and safety of anyone also extends to AI tools.

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DAVEY WINDER

# “One question I’m often asked is how secure it is to put all your password eggs in one basket”

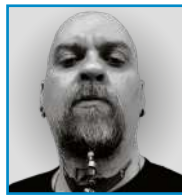
Davey explains why his mother’s maiden name is FthV5£frLObn37, and discusses the future of passkeys with 1Password’s chief product officer

Once upon a time, there was a huge company that, a couple of weeks after a patch for a critical vulnerability had been patched by the vendor, discovered threat actors had been poking around its networks. Sounds familiar, doesn’t it? However, this is a story with a twist in the tale: it’s not about timely vulnerability patching. It’s about passwords.

The firm in question is Comcast Cable Communications, trading as Xfinity, one of the US telecoms giants. The critical zero-day vulnerability labelled CVE-2023-4966, also known as Citrix Bleed, impacted Citrix NetScaler application delivery and gateway devices and has been exploited from August 2023 to steal authentication sessions.

CVE-2023-4966 earned a 9.4 CVSS criticality rating as it didn’t require user interaction nor privilege escalation and was exploitable remotely. Citrix published a security bulletin and a patch with a strong recommendation that users apply it urgently on 10 October 2023. On 18 December, a Xfinity spokesperson said: “We promptly patched and mitigated the vulnerability. We are not aware of any customer data being leaked anywhere, nor of any attacks on our customers.”

Other dates to take note of here are 16 to 19 October, when there’s evidence of malicious activity on the Xfinity network, and 25 October, when that evidence surfaced in the company. Fast forward to 16 November, and a security investigation confirmed that more than 35 million customers were impacted by the breach that included data exfiltration. On 6 December, Xfinity concluded usernames and hashed passwords were “in scope” of the breach. Password resets were then required for impacted accounts



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X @happygeek

and customers advised to enable two-factor authentication.

“This breach is particularly alarming,” said Darren James, senior product manager at Specops Software, “as the type of data that has been declared stolen indicates that passwords and answers to identifying secret questions and answers have been lost.” You might think that because exfiltrated passwords were hashed, the conversion of a plaintext password into ciphertext using an algorithm as a one-way function, they were 100% secure. If so, you’ve forgotten that nothing is 100% secure.

“Depending on the hashing algorithm used and the length of the password, it is still relatively easy to brute force these hashes back to clear text very quickly using relatively inexpensive hardware,” said James. And as far as I can tell, the answers to those secret questions weren’t hashed. “It is of extreme importance that anyone affected by this breach not only changes their Xfinity password immediately but also takes time to think about where else they may have provided the same answers to security questions, whether for personal or business use,” concluded James.

BELOW Comcast found threat actors had exploited a critical zero day vulnerability

### CVE-2023-4966 Detail

UNDERGOING REANALYSIS

This vulnerability has been modified and is currently undergoing reanalysis. Please check back soon to view the updated vulnerability summary.

#### Current Description

Sensitive information disclosure in NetScaler ADC and NetScaler Gateway when configured as a Gateway (VPN virtual server, ICA Proxy, CVPN, RDP Proxy) or AAA virtual server.

[View Analysis Description](#)

Severity

CVSS Version 3.x

CVSS Version 2.0

CVSS 3.x Severity and Metrics:

NVD

NIST: NVD

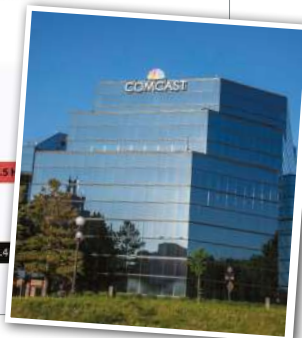
Base Score: 7.5

Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:N/A:N

CNA: Citrix Systems, Inc.

Base Score: 9.4

Vector: CVSS:3.1/AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:H/A:L



One way of ensuring your passwords and any additional information, such as answers to “secret questions”, are not only random and complex but also unique is by employing a password manager application to do both the creation and remembering bits for you. This is particularly important when it comes to those answers that are often used to enable a password reset should you forget it. I never give real answers to these. For example, my mother’s maiden name is FthV5£frLObn37 at one site and 8gsxe%\$ILU:nb at another. Neither of which I’d be able to recall were it not for the fact that my password manager takes care of all that for me.

## Password managers still rule

One question that’s not so secret – and I’ve been asked more times than I care to recall – is how secure it is to put all your password eggs in one application basket. Especially when that basket is floating around in the cloud.

Okay, first things first: using a password manager is, in most use cases, a far more secure proposition than not using one. Second, not all password managers use cloud syncing; some will allow you to store your password vault locally if that’s a major concern for you. However, for the vast majority of people, keeping your password vault in the cloud is more than secure enough.

Let’s look at 1Password, which is my application of choice. This has end-to-end encryption for data in transit, 256-bit AES data encryption, cryptographically secure pseudo-random number generators for encryption keys, initialisation vectors and nonces (no, not that type of nonce, rather an arbitrary number used once in a cryptographic communication to prevent authentication replay attacks). Key derivation strengthening then makes any attempt at brute-forcing a master password even harder. Oh yes, it also has a 128-bit secret key that must be used in conjunction with the master password before anything can be decrypted. A 128-bit secret key that’s created using your own device and isn’t known to 1Password. If a threat actor somehow managed to gain access to the 1Password servers, your secret key would still be needed to

decrypt your password data, and 1Password doesn't know this, doesn't store this, doesn't have this.

Yet towards the end of 2023, a story broke regarding research that led to a vulnerability known as AutoSpill. This apparently impacted six of the most popular password manager apps. Ankit Gangwal, Shubham Singh and Abhijeet Srivastava, security researchers from the International Institute of Information Technology in Hyderabad, India, shared their findings during a presentation at the Black Hat Europe hacker conference on 6 December.

The AutoSpill vulnerability is specific to Android's autofill function – more specifically, when used by a malicious third-party application to authenticate a user with the “log in with Apple/Facebook/Google” method. And that third-party application must be installed using a side-loading method outside of Google Play, or to have bypassed Google's malware prevention technologies and made it into the official store. None of these things is impossible, but they're unlikely and certainly far from the easiest method of stealing user credentials.

But let's play along for a bit. Let's say an Android app has called for that login using WebView, the Google component that enables Android apps to display web content (rather than launching a web browser). The autofill function should now activate and request the login credentials, and when the user invokes a password manager those credentials should be inserted automatically into the login field for the page that's being loaded.

With me so far? Good, because this is where things get complicated if AutoSpill is involved. Those credentials can also get shared, the researchers found, with the host app. In this case, the malicious host app. But don't forget that it's only credentials for another service, other than the third-party application calling for them itself, that are at risk here. So you've got to be fooled a number of times before the threat actors can get hold of that one single set of credentials.

If the scenario isn't too far-fetched for you at this point, then know that the password managers at risk according to the researchers, or at least the ones that they tested it against, were 1Password, LastPass, Enpass, Keeper and Keepass2Android. Using an additional JavaScript injection method to add to the trickery, DashLane and Google Smart Lock

were also susceptible. There remains no evidence at all that AutoSpill has been exploited outside of the research labs, and given the requirements outlined above I can't say that I'm overly surprised.

That said, the password manager firms have been quick to act. 1Password tells me that an application update will prevent native fields from being filled with credentials that are only intended for Android's WebView, in addition to users already being required to take explicit action when using autofill. Keeper prompts the user when attempting to autofill credentials into an Android application or website. LastPass mitigates with a pop-up warning when such an action is being attempted. Enpass patched the vulnerability with Enpass version 6.8.3 on 29 September 2022.

## Passkeys will rule

If AutoSpill is an interesting password-related development (albeit one unlikely to impact many, if any, real-world users), then passkeys is another with a much broader scope for real-world application. Yes, passkeys, the consumerisation of enterprise authentication standards such as FIDO and WebAuthn.

Launched some time back by Apple, Google and Microsoft, passkeys promise much but have largely been ignored by users. Most people I talk to outside of my inner circle of security-geek friends have either not heard of passkeys or are quite happy sticking with passwords thank you very much. Which is a shame, as passkeys really do hold a lot of promise when it comes to improving authentication security while at the same time making the process more user-friendly. If that's not the security Holy Grail then I don't know what is.

Google says passkeys are much faster to use than passwords – taking an average of 14.9 seconds to sign into Google compared with 30.4 seconds for passwords – and that four times more users successfully authenticate



**ABOVE** 1Password allows users to unlock their accounts with a passkey

**“If that's not the security Holy Grail then I don't know what is”**

**BELOW** Passkeys have largely been ignored by users, despite their simplicity

through same-device passkeys than the success rate typically achieved with passwords. The numbers continue to impress when you dig into them: 1Password has seen more than 700,000 passkeys created and saved by its users, with 334,000 trying out the passkey technology. 1Password told me there are more than 100 registered websites, apps or services in its passkeys directory, including Adobe, Amazon, Apple, GitHub, Google, Microsoft, Nintendo, Nvidia, Okta, OnlyFans, PayPal, Robinhood, Roblox, Shop Pay, Shopify, Sinology, TikTok, Uber, Virgin Media, WhatsApp (Android), Yahoo and Zoho. You can try them out for yourself as most password managers are now geared up for passkey use, or you could use the demo account at [passkeys.io](https://passkeys.io) to see how easy they are to create and use.

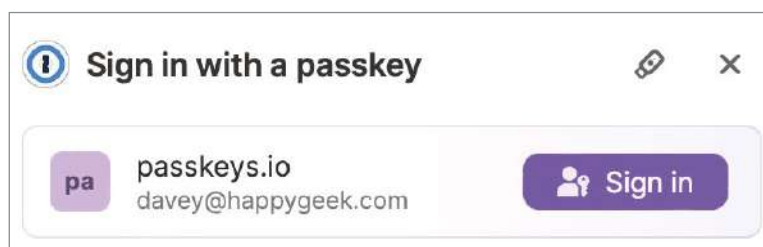
## 1Password mini interview

And finally, in December 2023 I spoke to 1Password's chief product officer, Steve Won, who explained why he thinks passkeys are the secure future in a passwordless world. Rather than paraphrase what he said, here's a word-for-word account of our conversation.

**Davey Winder:** Are passkeys that much of an advance in security terms for someone already using 1Password with strong/random passwords generated by 1Password, and a strong master password?

**Steve Won:** 1Password makes it convenient for users to generate unique, strong passwords – making

breaches far less likely because you're not reusing them across accounts. However, whenever there's a password, there's still something a bad actor can steal – typically preying







## Continued from previous page

on human error through the use of social engineering attacks, which unfortunately happens frequently in today's climate. According to Verizon's 2023 Data Breach Investigations Report, 74% of breaches involved the human element, which includes social engineering attacks, errors or misuse.

Passkeys eliminate passwords. Without passwords, there's nothing to steal, making social engineering attacks like phishing ineffective. Ultimately, every passkey is made up of two keys – a unique public key, which is created and stored on that company's server, and a private key, which is stored on the user's device. The public key is used to create a challenge that can only be solved by the private key. Because of this, passkeys are nearly impossible for hackers to guess or intercept because the keys are randomly generated and never shared during the sign-in process.

**DW:** When will you be able to use a passkey to replace your 1Password master password?

**SW:** 1Password is the first and only password manager to allow users to unlock their accounts with a passkey. On 14 December, we launched unlocking 1Password with a passkey in public beta – replacing the account password and secret key combination for new individual accounts – and have plans to make this generally available in the new year.

**DW:** Are there any disadvantages with passkeys?

**SW:** Despite strong user adoption sparked by passkey deployments from tech giants like Apple, Google and Amazon, we're very much in the first quarter of passkeys. We've used passwords for decades, and they're just too ingrained in our culture to go away overnight. Ironically, passkeys can also seem almost too easy to use. And when users feel it's this easy, they question if it's really secure because security typically means friction. We still need more companies to implement passkeys for them to be more widely adopted, but with limited resources and budget, it can be a long adoption curve for websites and apps to build their own authentication infrastructure.

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## STEVE CASSIDY

# "The main reason I have an antipathy to TeamViewer is I've been through its nag process"

If you've been caught out by auto-renewing software licences, Steve has some practical answers for both personal and business use

**A**s President George W Bush tried to say: fool me once, fool on me. Fool me twice... err, well he didn't remember the rest of that and I'm too hopping mad to do any better. The occasional bit of unhelpful behaviour from any software is to be expected, but when three separate companies all act the same way at the same time of year, one begins to run out of forbearance.

This column is about Software Behaving Badly, but I'm not thinking about irritating dialog boxes. It's all in the billing system. In my case, Microsoft and TeamViewer both decided to renew my licences in the same month: both annual, both over £200, both with a whole bucketload of cheery emails telling me that this was an annual renewal, that it will happen again this time next year and, most importantly, I'd missed the boat to stop it from happening.

You might expect me to take a dim view of almost anything TeamViewer does, the phone scammer's remote-control tool of choice for so long. But the main reason I still have an antipathy to TeamViewer is that, like almost every techie, I've been through its nag process. This is the series of pop-ups, reminders, warnings and emails saying you're unlicensed and really should do the right thing before you lose the ability to connect to a remote machine altogether.

A few years ago, my heaviest TeamViewer-using client was paying in excess of £1,500 a year for an unlimited licence. This client said that demands for cash would turn up a little too often, and too surprisingly, for it to be entirely comfortable. I guess that's a leopard/spots thing – an early warning of worse behaviour to come.



Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart  
[@stardotpro](https://twitter.com/stardotpro)

"How I wish I'd not clicked 'Next' in that setup wizard!"

**BELOW** TeamViewer will bombard you with reminders about your licence

In the case of TeamViewer, the fix for this behaviour is to bite the bullet and move to another remote-support utility. But which one? The last time I searched, I found 60 rival apps, 20 of which had outgrown their cloud-based roots and were trying to muscle in on the older, traditional PC corporate support suites. I expect the balance is about the same today, so if you're being hit with renewal emails your best course of action is to take the renewal fee on the chin and pay again for the few months of overlapping utilities while your hard-pressed IT guys run a replacement rollout.

In the case of Microsoft, I'm sad to report exactly the same behaviour as I had from TeamViewer. Silence as the licence renewal date got closer, then a sudden outbreak of emails peppered with phrases such as "you can cancel next year" and "just look at the benefits!" while printing the renewal fee in a small font, way down in one corner.

Some background. I have a Microsoft account, as I am sure almost every IT professional does, and I'd used it to log into a test laptop, because that's what Windows 11 asks the typical user to do. How I wish I'd

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## What you can do to prevent software companies grabbing your money

### Use burner cards

It looks like a credit card, it works like a credit card – but it gives you no actual credit. You have to top it up before you can spend a kopeck, but here that's an advantage. It means that no drawing down "below zero" is allowed. You can bet that the various unscrupulous online billing systems will advise you in plenty of time that your card is about to expire or is unable to accept payment requests.

### Have the conversation with your boss

That is, the conversation about personal versus company payment methods. There are as many opinions and experiences in this field as there are accountants, finance directors and entrepreneurs. The objective is to make sure that any nonsense from online subscription-style payment demands can't interfere with your personal balances, credit ratings and so on. If it's important for businesses to maintain current licences for their software, then relying on a registration process that wants to use a named person's card is a strategic error.



Who does the software belong to if or when the named member of staff leaves the company?

### Make contact with the subscription operator

Microsoft has always been willing to cut a deal away from the sight of Joe Public (though I remember one early corporate licence negotiation that resulted in a high-topped Luton van pulling in at the forecourt almost

**LEFT** A credit card that doesn't give you any credit can help stop unscrupulous billing systems

flat on its springs, the back stuffed full of cellophane-wrapped 30-floppy install kits for Office). Big software houses can't afford to build relationships with individuals, but it's the one thing they can't afford to stop doing when it comes to bigger deals with more products and licences to manage. Take advantage of this whenever possible.

### Always have an exit strategy

The most important process to control when signing up to a cloud service isn't billing or scalability: it's the exit strategy. How could your company or department stop using cloud resources, in the event that suddenly the cloud charges increase sharply, or your business premises is rendered unsuitable by strong price hikes in cloud-ready internet access? Waiting until you see an invoice as evidence of this type of trend is way too late if you want to get that money back.

not clicked "Next" in that setup wizard! My Microsoft account is, it turns out, a deeply strange, decades-old, stunted financial doppelganger. Built first on an Xbox for watching pay-per-view movies, it later morphed into a cost centre for invoking Azure virtual machines. Perhaps I shouldn't have been surprised that in late 2023 my Microsoft account was a wide-open road to my finances, while at the same time refusing all efforts to apply those handy password-forgotten rules that so many people depend on as their best effort in online security.

I didn't expect the financial aspect of my account to still be live and usable in 2023, with the Office licence not having been renewed since 2018. But not only is it live, it's happy to collaborate with the Microsoft 365 team's decision to swipe its fee in the late autumn of the year, without any form of assent from me. Turns out Microsoft can send me 50 SMS messages when I have a new email, but when it comes to money, everything goes quiet.

This is what Software Behaving Badly really means. If a vendor wants to mount a payment raid on a portion of its customer base, then it's child's play. Even if we believe they have



broken consumer law in the territory they're looking at, there's little we can do. It's impossible for a private individual to stand up to a global corporation in a civil court, and while there are prominent legal cases in progress between equally large entities (the EU springs to mind), getting that money back down to the grassroots from whence it came relies on goodwill.

### Farewell Firefox?

I don't like to boast. But, rather like Jon Honeyball, there are bits of my network that are frankly ludicrously oversized for the use I put it to.

As such, I was sure that my network didn't exhibit any nasty

**ABOVE** Microsoft is no better when it comes to software renewal reminders

**"The slowness was in the browser I was using to search for symptoms of slowness"**

little performance-slugging configuration decisions. I have a 10GbE backbone switch, three HP ProCurve managed fanless switches for PCs, TVs, WAPs and Macs to connect to, and a fibre patch lead between floors. I'm used to this setup remaining incredibly stable, while keeping up speeds often in excess of 150MB/sec.

So it was with a sinking heart that I found my main machine was in the throes of rebooting after a sizeable update – and things seemed to be going very slowly.

Once logged back in, I went looking online for any write-up on the big update that might point to a reason for the slowdown. Opening Mozilla Firefox, I sat and waited for the various pictures and ads to open. And waited, and waited. I distracted myself by composing search terms to aim for the heart of the issue, but had run out of dreamed-up keyword schemes long before the default home page had finished loading.

The main symptom of slowness was in the browser I was using to search for symptoms of slowness. Other browsers on the machine were quite normal. I switched to Chrome, only to find that my search on this subject came up empty. Those neat AI-driven summary pages you now see at the top of a page of search results barely rose above the level of "turn it off and on again" or "undo the last update and wait for a fix". Most concerning, Mozilla itself



Support
moz://a
Get Help
Contribute

Home / Support Forums / Firefox / Firefox is terribly slow after...

This thread was archived. Please ask a new question if you need help.

## Firefox is terribly slow after latest update. Nothing fixes this!

4 replies 26 have this problem 250 views Last reply by RayLinStephens 5 years ago

**ballyglas**  
22/11/2017 23:36

Trying to submit a trouble ticket on the slowness of Firefox since the last update. It's so bad I'm thinking of switching to another browser! I've re-set the browser, re-started the laptop and Firefox is STILL slow. There doesn't seem to be a way to contact support directly. This is terrible.

Chosen solution ✓

**LEFT** The venerable Firefox browser may have breathed its last on my system

**"I can't wait for the mainstream suppliers to figure out that the inner city needs attention"**

**BELOW** Openreach vans have been ubiquitous round my way recently

This means that we can't use a public IP address, and our routers have sockets for regular telephones (because they pre-date the analogue phone network shutdown) and accompanying setup instructions for smart TVs. It's true that many other suppliers share these home internet assumptions. Certainly, a lot of my neighbours didn't seem to have any other requests or designs when it came to their home networks.

Of course, I do: and that's why I'm positively ecstatic at the prospect of Openreach fibre being squeezed down the 1940s conduits that link me to the rest of the world. I'm not choosing our national carrier – Openreach is owned by BT Group – on the basis of blind faith (unlike a lot of my neighbours), but because I know our current connection is provided by a very small, very specialised business. The Openreach fibre rollout, on the other hand, is as general purpose as it can make it.

That matters to me because it means other internet providers can deliver services over Openreach's fibres. And that means I can knock on the door of my friends at Andrews & Arnold, who are so nerdy they will do you a complete IPV6-only internet access connection with more available addresses on the inside than there are stars in the sky. That's what I've been dreaming about for at least the past five years, maybe even ten: one of the agonies of the bleeding edge in the 21st century.

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made no announcement. The only decent write-ups I could find referred to new features added to Windows with the update: you can start exploring these at [tinyurl.com/354firefox](http://tinyurl.com/354firefox). Sadly, I think this is a problem that's here to stay.

It will be hard to justify sticking with my old faithful browser if Mozilla is now so far out of the loop on Microsoft update behaviours that changes to the clipboard code, or new components intended to block access to fake domain names or malware websites, leave it and its users (a mere 2.8% of the internet, but that's still millions of people) high and dry with machines that had been perfectly usable before the update landed.

Of course, Microsoft is equally to blame. You could even say that it is shooting itself in the foot. It has made an immense effort to get its cloud service platform to be Linux-friendly, and many distros include Firefox as their default browser. I'd expect the uproar to be visible from a Falcon 9 booster if that platform had been broken by an architecture-shift disguised in an update.

### Fibre to your door: it's not over yet

We have recently been invaded. Vans liveried for almost every supplier of broadband have been turning up, mostly in little groups: BT, Hyperoptic, Openreach. It has become hard to tell one engineer from another in their obligatory

hi-viz jackets. Not even the tiddly reels of fibre they carry in and out of the tower blocks can be used to work out who's who.

Fibre right to your door has been a long-touted dream. Even though we have had it here courtesy of an ultra-dense-living provision specialist for several years, I can't wait for the mainstream suppliers to finally figure out that the inner city needs attention, just as much as the boondocks. This isn't because our early fibre install is performing poorly (although we've had some dreadful outages due to disaffected techies and foolhardy maintenance work), but rather that the configuration of the connection sits firmly in the consumer access world.



# RETRO



Inspirational stories from computing's long-distant past

## How Grand Theft Auto stole hearts

As excitement builds for the latest instalment of *Grand Theft Auto*, David Crookes looks at how the first game shot to glory a little over 25 years ago

**R**ockstar Games recently unveiled a 90-minute trailer for *Grand Theft Auto VI*. Within a single day, it had been watched 90,421,491 times, making it the most viewed videogame reveal on YouTube in 24 hours, according to Guinness World Records. Many millions more have watched it since.

Such excitement was to be expected. The *Grand Theft Auto* franchise has long been a smash hit – sales of the crime series have reached 410 million copies, firmly placing it in the top five best-selling franchises of all time, behind *Mario*, *Tetris*, *Pokémon* and *Call of Duty*.

It's easy to see why, too. The games allow players to indulge their dark side, letting them loose in a vast environment to enjoy an open-world adventure with few rules. Across the series, gamers can steal cars and planes, rob banks and people, engage in shoot-outs and fight it out with cops. It's also possible to get drunk, watch TV, go to the cinema and play a game of tennis or golf... before running red lights and running over pedestrians.

Wholesome it ain't, but the carefree approach is only part of the story. During the course of such mayhem, the series has taken a satirical swipe at American culture, explored social issues and spawned a genre of its own. Importantly, the games, as uncomfortable as they can be at times, are also laden with humour, having been developed with tongues firmly in cheeks. They've been created to empower people to feel free and, above all, have fun.

### Born of passion

When the first game was released a little over 25 years ago, no-one could have foreseen the impact GTA would have had. Back then, Dundee-based developer DMA Design was simply looking to build a game its team would want to play themselves and that, initially, didn't involve taking on the role of a low-level gangster. Instead, there had been a plan to create either a city simulator or a top-down racer.

DMA Design's co-founder Mike Dailly got the ball rolling. "He had built a cool top-down semi-3D scroller," said Keith R. Hamilton, GTA's team lead and lead programmer. Hamilton had just completed his first commercial game – "I'd been lead programmer on the PC version of *All New World of Lemmings*" – and was looking round for his next title. "As car enthusiasts, we were keen to do a top-down racing game, and it came together nicely with Mike's prototype."

A decision was made to work on a top-down racing game based in a city. It would be called *Race'n'Chase*, and the idea was to create a



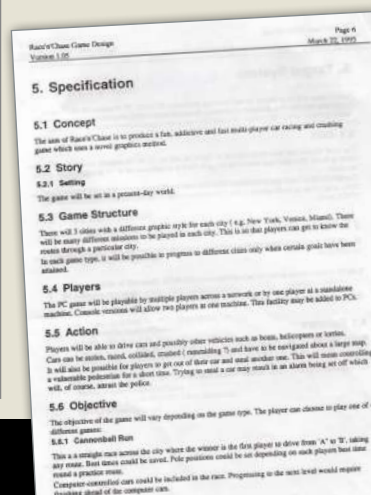
**ABOVE** The new "bad boy" of computer games hits the shelves

straightforward cops and robbers game with the player assuming the role of the good guy – the chasing cop. But the team decided they wanted to spice things up and allow players to drive any vehicle they wanted, and that posed a little problem.

"Just driving cars was not enough so we introduced playing on foot," Hamilton told *PC Pro*. "But how do you explain going from on-foot to driving a car that you weren't driving? Theft! And so the game evolved."

**"The series has taken a satirical swipe at American culture, explored social issues and spawned a genre of its own"**

In an instant, the game effectively turned into a sandbox, car-based crime sim. Nothing was off limits, and the aim was to let most of the fun situations just happen because of player interaction rather than because the developers wanted them to be that way. "We didn't write a story and build a game around it, we evolved a gameplay mechanic and then imagined a background to explain it," Hamilton continued. "But the team was chaotic, quite inexperienced, and I think the game reflects that."



**LEFT** The concept for what was going to be called *Race'n'Chase*





## ■ On a mission

In a bid to help the development run more smoothly, Hamilton wrote a design document on 25 January 1995. It was revised five times, with the final version written on 21 March following several meetings. The document proposed “a fun, addictive and fast multi-player car racing and crashing game” using “a novel graphics method”.

It suggested there would be three cities, a host of missions and an ability for players to “drive cars and possibly other vehicles such as boats, helicopters or lorries”. Crucially, Hamilton said cars could be stolen, raced, collided and crashed. “It will also be possible for players to get out of their car and steal another one. This will mean controlling a vulnerable pedestrian for a short time. Trying to steal a car may result in an alarm being set off which will, of course, attract the police.”

DMA Design allocated the game a budget of £1 million and work began on the DOS version, with the PC becoming the game’s lead platform. “The game was very much built on PC and for PC, which was quite wasteful in memory and CPU usage in hindsight,” Hamilton said. “The engine was written in assembler but the vast majority of the code was written in C, which was a first for DMA because all previous games had been the other way around.”

“Using a higher-level language like C was what enabled more complex gameplay than our previous games. Of course, it also enabled some really complex bugs, and we had to implement a recording system to capture them. For example, the game could crash randomly after playing it for half an hour – eventually tracked down to a fire engine hitting a pedestrian slightly off-screen.”

Although PCs were powerful enough to handle full 3D, a decision was made to stick to the pseudo-3D top-down perspective created by Dailly. It allowed gamers to see what

was going on around them and it meant the developers would have more time to work on creating a living, breathing city, putting gameplay over graphics.

“We built the game around the engine and the initial gameplay mechanic – full 3D was never really considered,” Hamilton affirmed. “We were concerned that the look of the game was quite dated compared to other games of the time, but our tech efforts were very much focused on gameplay rather than visual effects. Our art team had a challenging job to keep the game looking fresh.”

As development continued, the game evolved. The multiplayer aspect of the game was dropped and the structure of the game was refined. Further suggestions were made by members of the team, although some were briefly considered then cast aside for various reasons (there was a plan to allow players to drive combine harvesters to mow down pedestrians, but this was dropped because the team didn’t have sufficient time).

“Most of the experiments ended up in the game: theft, open world, police, ambulances, trains, tanks, Hare Krishnas,” Hamilton said. Indeed, players were able to mow down a bunch of Hare Krishnas and earn a Gouranga bonus (a Hare Krishna mantra meaning “be happy”). “The hard bit was putting a stop to all the suggestions to get the game actually released.”

## ■ Bang bang

Given the ambition and scale of what DMA Design was trying to achieve, the team missed all of their milestone deadlines. They were supposed to have completed the project on 1 July 1996, but that date came and went. Even so, the team was obviously on to something. They were

**ABOVE LEFT** An early prototype of *Race’n’Chase* was ripped up because it looked too similar to *Syndicate Wars*

**ABOVE** A second prototype became the basis of the original *GTA*

**“Our tech efforts were focused on gameplay rather than visual effects. Our art team had a challenging job to keep the game looking fresh”**

**BELOW** The graphics looked dated even for 1997

creating an edgy city that felt alive, although Hamilton wanted to go even further in that first game.

“I was very interested in the simulation aspect – the more the city functioned in the background, the more fun the player could get from interfering with it, noticing that they were having an impact on the world,” Hamilton continued. He wanted to create traffic systems, repairs, diversions and more. “But we moved away from this towards scripted missions to give the game more of a storyline.”

Still, there were some lovely quirks. Cop cars would drive from the police stations to the scene of a crime and ambulances would make their way to and from hospitals, stopping to place injured people on stretchers. The missions also worked well: there were 90 of them spread across Liberty City, San Andreas and Vice City (based on New York City, San Francisco and Miami), and they’d involve driving to locations, stealing and delivering items, killing and kidnapping people, blowing stuff up and having cars resprayed. Communication was via public phone booths and pagers.

The latter features were important. Initially, the game was going to be entirely based around the missions, which would be manually selected –

complete one and you’d be asked to choose another. But the level selection ended up being effectively built into the game itself. Players would be able to do their own thing and choose to embark on a mission if they wished.

## ■ Surviving is winning

Trouble is, all of this made for a very complex game, and testing was difficult because it was hard to second guess every move that a player would make. The team cracked on, however, doing their level best to create a winning game. “There were, I think, 20 to 30 people – code, level design,



art, sound, QA – all very talented but mostly quite inexperienced at the time, all with an input on the direction of the game. It was chaotic but I believe the game benefited from that. The challenge was to get it finished.”

Development didn't always go smoothly. “There were heated arguments and it became very stressful at points,” Hamilton recalled. “We were concerned about getting the game released before being eclipsed by the competition. We were concerned about it being cancelled. We were concerned about the bugs getting out of control. It was fun at first but there was a lot of late-night work and stress to actually get it finished.”

Some of the team's fears were well founded, with the game nearly cancelled on numerous occasions. One time, DMA Design co-founder Dave Jones had to persuade American executives from game publisher BMG Interactive that the game was worth sticking with despite the presence of outdated graphics, bugs and the lack of a clear genre.

“They'd flown over and were hugely unimpressed about the lack of graphical quality in an unfinished game that they had pumped a lot of money into,” Hamilton said. Yet, in general, the more people heard about the game, the more they were intrigued. “The confidence of the team was transformed when we put out a demo version and had a hugely enthusiastic response. We then knew it was going to work,” Hamilton said.

## Crime pays

To attract more interest, publicist Max Clifford was hired by BMG Interactive to tip off the tabloids about the game's content. As word spread, more people began talking. Lord Campbell of Croy infamously raised concerns in the House of Lords on 20 May 1997, months before the game was even released.

“Is it true, as reported, that the game includes thefts of cars, joyriding, hit-and-run accidents, and being chased by the police, and that there will be nothing to stop children from buying it?” he asked. “To use current terminology, is that not ‘off-message’ for young people?”

Proving that there is no such thing as bad publicity, interest among gamers soared. *GTA* was given an 18-rating by the British Board of Film Classification, which assessed videogames at the time, and it was

**RIGHT** *GTA VI* is getting gamers very excited – and it shows just how far the series has come



**ABOVE** Getting a criminal record was a badge of honour in *GTA*

worn as a badge of honour, with an advertisement proudly proclaiming: “Grand Theft Auto is so good, it won a certificate before it was even released.”

It also helped that the game's reviews were so positive. *PC Play* awarded the game 92%, *PC Zone* gave it 92% and *PC Gamer* also handed it 92%. *C&VG* was so impressed it gave *GTA* five out of five. And when *Escape* magazine printed, “Grand Theft Auto is depraved, disgusting, putrid and repellent, 6 out of 6!”, DMA Design said it confirmed “the truism that adults really do have all the fun. Sorry kids. Grow up and see what you're missing.”

For the developers, such attention was also a relief. Having been worried about the future of the project, they now knew they had a special game on their hands. “The team was very excited to see any news about the game at all,” Hamilton said. “The level of controversy was unexpected and exciting – not unwelcome. We were confident in the content of the game by that point. Reports of the game not being fun to play would have upset us, but media stories about the content did not.”



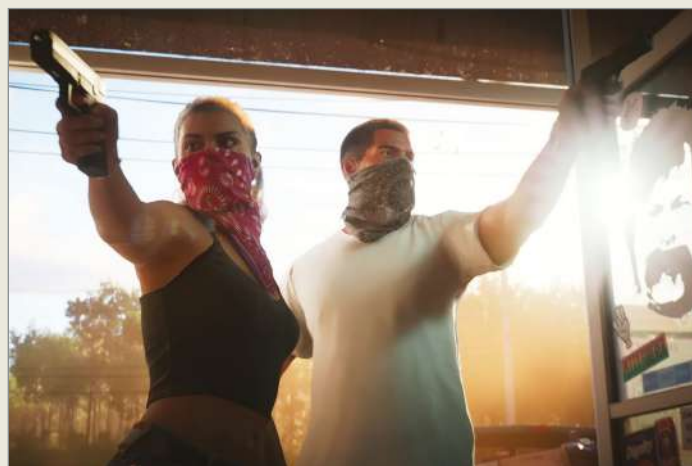
**ABOVE** *GTA* was proud to receive an 18+ rating from the BBFC

horribly hampered by the original codebase and as a result was hugely inferior to the PC version, much to my regret to this day,” Hamilton said.

Regardless, a countercultural phenomenon was born and a sequel was created two years later, along with London expansion packs for the first game. The franchise moved to full 3D with the groundbreaking *Grand Theft Auto III* in 2001 (at which point DMA Design was renamed Rockstar North). This was followed by *Grand Theft Auto: Vice City* in 2002 and *Grand Theft Auto: San Andreas* in 2004, *Grand Theft Auto IV* in 2008 and *Grand Theft Auto V* in 2013. The next instalment, *Grand Theft Auto VI*, is due for release in 2025.

Given the gap of 12 years between *GTA V* and *VI* it's little wonder there's so much anticipation, and Hamilton is among those eagerly awaiting the next game. “I'm as excited as everyone else to see *GTA VI*. The technical advances, storylines and cinematic quality of the newer *GTA* games have transformed it into something on an epic scale that we could never have imagined developing the original,” he said.

He contends, however, that the ethos of what makes *GTA* so special has changed very little from the original concept all those years ago. “It's mind-blowing what they've done in the later games, and yet the original team can be proud that the core gameplay mechanic and sense of fun remains,” he said. “That sense of fun is why *GTA* games have proven to be so successful and popular, above all else. Violence is a side effect of that. It's not the point of the game.” ●





# Futures

We explore the trends and technologies that are set to shape the future

## Better broadband by drone, AI and VR

Openreach gives **Nicole Kobie** a guided tour of the cutting-edge consumer technologies that it's using to improve broadband across Britain

**T**o upgrade a broadband connection in Wales, Openreach had to get a line through a wooded valley and across a river. In short, it wasn't going to happen. Either an engineer would have to risk their life wading through the water or the broadband infrastructure company would need to spend months on expensive works along the side of the road, requiring permission it might not get.

So the 20 houses were left unconnected – until one engineer at BT Group's infrastructure arm had the clever idea to use drones, dragging the cable through

**BELOW** Openreach is using drones to lay cables in remote areas



the air to the tiny village, where an engineer waited to catch it.

"We got the drone up, flew the cables over the trees and river, and up the other side," said engineer and drone pilot Gary Taylor. "We were able to give them service which otherwise we would not have been able to do... We can get a customer online within hours instead of two, three or four months – it's a no-brainer."

Taylor has worked for Openreach for nearly two decades, but before that he was a pilot. So when the company sought innovative solutions to

long-running problems as part of its regular corporate Challenges, where staff pitch and workshop their ideas, it was only natural that he thought to take to the air.

Drones are no longer the stuff of sci-fi. Instead, they're off-the-shelf consumer technology that any child can pilot – and that makes them a cheap solution when used in cutting-edge ways. Alongside drones, Openreach has turned to VR to aid planning permission, AI and 360° cameras for surveying and automated audits, and solar panels to roll out ultrafast wireless broadband quickly to areas without the usual power networks in place.

The aim is to reach those in the most remote regions, and also to boost



the fibre rollout in urban areas – after all, if a technology works in the middle of nowhere in the valleys of Wales, it could be of use in cities, too. Either way, these innovations not only help link up those still struggling on low-quality connections or stuck using satellite broadband, but also quickly reconnect communities hit by disasters such as floods. Not bad for technology that many people consider playthings.

### ■ High flying, high speed

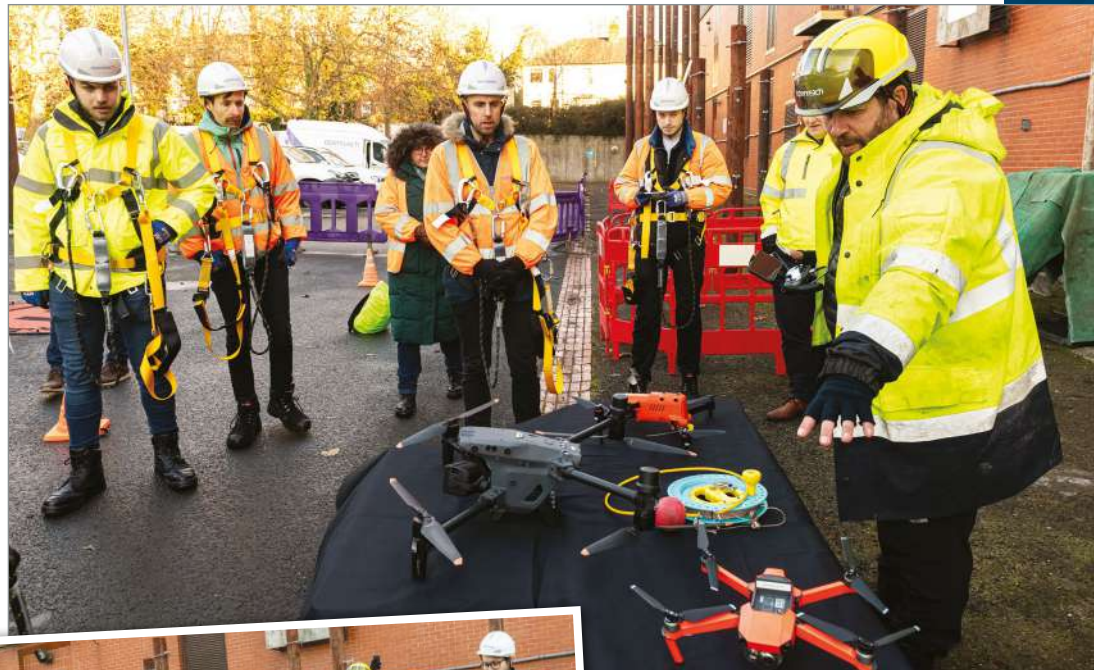
Openreach now has 16 drone pilots dotted around the country, rolling out high-flying, high-speed connections, but the idea has also taken off across the wider BT Group, with more than 120 pilots company-wide.

And no wonder. It's an idea charming in its simplicity. The project uses off-the-shelf drones – Openreach has a variety of the latest DJI models on show – and adds a 3D-printed hook on the rear bottom. That hook is removable, as aviation authorities require the drones not to be structurally changed.

From the drone hook, the operator hangs an unwieldy basic-looking contraption: a metal loop, like a small keychain, attaches to the drone; from that dangles a yellow length of cable that connects to a reel of fibre and what looks like a tennis ball. The fibre needs to be carried far enough below the drone to avoid disrupting its flight, and the ball helps stabilise the whole package. It looks bodged together, but in a good way.

To lay fibre across a forest or river or other obstacle, an engineer stands at one pole, holding the end of the length of fibre. The operator sends the drone up, trailing the fibre behind it. The flight takes just a few minutes, and once the drone arrives at the second pole, it simply turns around and flies back. Because the 3D-printed hook on the rear of the drone is open, the fibre-carrying contraption simply slides off it, falling to the ground to be collected by an engineer. Each length can then be attached to the top of each pole, connecting the distance without any danger to engineers – or trees. “We’re saving on tree cutting, we’re not putting more ducting in the ground – environmentally, it’s very good,” said Taylor.

The drones have been put to use in cities, too. Rows of terraced houses are a pain for engineers, because they might need to ask every single resident for access to their gardens to upgrade a link between two poles. Instead, Openreach can simply get access to gardens where the poles are situated, and then fly a drone between them. (The company has special permission for its trained



engineers to fly drones over inhabited areas, which is normally banned by the aviation authorities.)

The drones are handy not just for planned rollouts, but disaster response as well. First of all they can be sent up for quick repairs, but the drones can also be used to survey damage using cameras, thermal imaging and Lidar, as well as watch over staff in the field.

“With climate changing like it is at the moment, we’re getting a lot more disasters, flooding, landslides and things like that,” Taylor said. “If we’ve got a scenario where we’ve got engineers having to go into water, which is typical in these circumstances, because these drones have Lidar and thermal imaging they can keep track of them from the command centre.” They can even keep an eye on engineers’ body temperatures to make sure they aren’t getting too cold.

In one example, a Scottish village was hit by a landslide, completely losing key infrastructure including electricity and phones, as well as gas. Drones were used to haul pipes and cables up the

hill. “We got that village back up and running within 24 hours,” Taylor said.

Beyond rolling out fibre, the drones are also being used to help map the network and keep an eye out for copper theft, with older lines using copper cables targeted by thieves.

### ■ VR for access

Virtual-reality tools don’t help roll out broadband directly, but they can help Openreach with one tough challenge: getting permission to upgrade systems. Not everyone is happy allowing infrastructure engineers into their properties to install new boxes or route fibre cables, and seeking permission for access or approval from local authorities can slow progress.

This is especially true with unique or listed properties. To address this, Openreach worked with VR company Digitalnauts to create a system capable of scanning properties using basic hardware – in some cases, just an iPhone – and render the view in digital 3D. Openreach can then show building owners or local authorities what the impact of installation may be, and even let them move boxes or cables to more aesthetically pleasing locations. “We can’t go in and automatically upgrade, so we need their permission,” said Will Pryke, head of open innovation and tech scouting at Openreach. “Which is where this piece of kit comes in – it really helps to show them what it’s going to look like and we can take them along.”

**ABOVE** Drone pilots demonstrate how the cable-laying device works

**“We’re saving on tree cutting, we’re not putting more ducting in the ground – environmentally, it’s very good”**

**BELOW** The only customisation to each drone is adding a hook





In one example on display, Openreach created a virtual walkthrough of flats in London's Barbican, a beloved brutalist and listed estate. The VR was like walking around a video game, except instead of taking head shots of zombies – or whatever happens in games these days – the purpose is to more clearly show the impact of an installation. "If you go running up the stairs, you can actually fall off, which is entertaining," Pryke said, while virtually walking through one section of the estate.

Openreach believes this use of VR could help with what it calls "multi dwelling units" (MDUs) and what the rest of us refer to as blocks of flats. Openreach is allowed to access the communal areas of such buildings to maintain or repair existing copper networks, but doesn't have the same blanket permission to install fibre. That means fibre goes only to the exterior of many buildings, rather than all the way to flats – and Openreach figures this impacts as many as 690,000 MDUs.

The hope is that Openreach can digitally show MDU managers and owners that the work will have a limited impact on residents and the building, smoothing the process. What's more, keen MDU owners can scan their own properties, helping to show Openreach what to expect without necessitating a visit from an engineer, speeding up installation. The system is also being used for more sensitive sites, such as those run by the Ministry of Defence, which didn't want to allow access to anywhere that wasn't necessary.

Beyond planning permission, Openreach is also using VR for training purposes, in particular for engineers learning to work with power cables – letting them practise without any risk of electrocution.

### ■ Smart Street View for broadband

Openreach's network is massive, stretching the length and breadth of the UK, give or take a few remote places. Planning how to expand and upgrade the network currently requires an engineer to run a manual survey – a technical euphemism for "taking a walk with a clipboard and camera". Not only does this take time and staff, it often requires revisits to sites if local authorities want to check another angle or viewpoint when considering planning permission.

"We have to get wayleaves and sign-off from councils and highways agencies that want to see what we're doing, but then they often say 'we're not sure about this, let's go on site to

discuss it'," said Pryke. And that's a pain point for Openreach as it takes weeks or months to arrange. "So we're driving the route with a 360° camera to review online."

The solution being trialled with a trio of cameras in Scotland is both simple and high-tech. Like Google Street View for broadband, Openreach vehicles with 360° cameras on the roof are sent along potential routes, recording detailed images of existing infrastructure such as cabinets and poles as well as the wider context – think homes, businesses and roads. Rather than shell out for expensive, complex software to render and share the clips, the videos are uploaded to a private YouTube account, so they can be viewed by planning authorities.

Alongside the mobile cameras, Openreach is trialling AI that can spot key infrastructure, such as access points like sewer covers and footway boxes, as well as existing cabinets and poles. That audit is necessary as Openreach doesn't have a perfect picture of its own network, which is perhaps no surprise given its age and size. The AI system can spot infrastructure and, because the video is geotagged, reconcile it with Openreach's existing records.

### ■ Solar and wind for rural connections

There are some places so remote that power lines don't reach them – and broadband needs power. Openreach has come up with a solution: wireless networks powered by wind turbines and solar panels.

The system will start from a standard fibre exchange, with a cable link connecting to a more remote base station – essentially a mini cabinet in the wilderness – that houses a battery to store enough backup power for two to three days of operation, as well as a remote diagnostics system to help



**ABOVE** The project uses off-the-shelf drones from DJI

avoid engineers needing to visit. That base station is paired with a pole that has three key technologies mounted to it: a small wind turbine, solar panels and a wireless transmitter that can broadcast broadband signals as far as 7km. That signal can be

### "Like Google Street View for broadband, Openreach vehicles with 360° cameras on the roof are sent along potential routes"

picked up by a receiving dish mounted to the home or business, or by another pole to daisy-chain and cover further distances.

Installing the system is much quicker than traditional methods – the

time spent depends on whether a pole is required – and cheaper than installing power lines to remote locations. More generally, the radio link system can also be used to provide connectivity while a community waits for a full fibre link to be installed.

So far, about ten sites are live. The first location was a fish farm in Lochcarron, Scotland, where the setup has successfully provided a 300Mbps/sec connection for more than a year, despite the inclement weather. Before the system was installed, the location had no fixed and little mobile connection. "The other customer we've got that we're looking at for a possible installation of a trial site is completely off grid – no mains, no running water," said Pryke. "It's completely isolated."

The quick installation means the green-powered, high-speed fixed broadband can also be used in emergency situations, with Openreach working on mobile systems mounted on vehicles for park-and-go broadband – turn up, connect, and walk away. Whoever thought the future of fast broadband could be so easy? ●



**BELOW** Virtual reality helps Openreach get permission to upgrade its infrastructure

# PC PRO

# Next month

**ON SALE**  
7 March 2024

## Features



### Copilot lands at last!

Now that Microsoft 365 Copilot has finally gone on sale to all, we reveal everything you need to know about this AI productivity tool.

## Features



### Gigabit fibre broadband gamble

Chances are that you're being offered a low price for gigabit fibre broadband from a local supplier, but are there hidden dangers?

## Features



### Boost your Wi-Fi for free

Darien Graham-Smith explains how to create a heatmap of your Wi-Fi network, and then take practical steps to improve coverage in slow areas.

## Labs

### Security suites

Should you stick with Windows Defender or switch to an alternative free choice? And what exactly do all the paid-for suites offer you? We reveal all in next month's Labs.



## Retro



### The SAM Coupé story

Who would release an 8-bit computer in 1989? British upstart Miles Gordon Technology is the answer, and David Crookes reveals the full story of this remarkable machine next month.

## The Network



### Cloud storage

Don't stick with Google Drive or Microsoft's offerings out of inertia. Dave Mitchell casts his eye over four business-specific services and explains what to look for.

## Futures



### Robots make you lazy

Research suggests we turn off our brains when we have a robot teammate at our side, but is that really true? Nicole Kobie switches off ChatGPT and investigates.

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# Jon Honeyball's first drive of a Tesla isn't an entirely appy experience

**I** have been pondering on the nature of the relationship between us, the users, and the software that comes with new products. In the dim and distant past, we were expected to invest time into learning basic tasks. Hence the rise of courses covering "Microsoft Office Skills" and even – yes, it's true – keyboard and mouse operation.

Today, everyone has these skills. Age is no longer a barrier, to the point that most everyone can pick up a computing device and understand how it works. And nowhere is this more true than phones. When we load a new app, we don't want to study the basics of its operation: we expect instant results.

For the trip to CES in Las Vegas, I decided to fly to Los Angeles, pick up a rental car and drive over. I've had too many bad experiences at LAX to trust it with a connecting flight, and it's simply quicker to drive.

Looking at Hertz's rental options, there was one obvious choice: the Tesla Model Y. Not only was it cheap (around £300 for ten days), it was a prime opportunity for me to try the platform. I had never driven a Tesla but several of my friends swear by them, and I'm very aware of the almost religious love that they have among their fanbase. A quick check of the Tesla website showed plenty of Supercharger options between Los Angeles and Las Vegas, and numerous charging options in Vegas itself.

Hertz's pre-flight emails were clear and concise. Install the Tesla app and this can be your digital key. A QR code on the car's windscreen would set everything up. There were other explanatory points in the email but, I thought, how hard could it be?

I arrived at LAX after a pleasant but sleepless flight and took the bus to the rental lot. Within minutes I was sitting in the car. This is where things started

to unravel. On zapping the QR code, the app reported: "Add Vehicle Error. Account incompatibility detected, we'll be adding support for it soon."

Well, I thought, I just need to drive the thing from A to B, so I all I need right now is the route. Cue much stabbing at the screen, and some muttered obscenities, until I finally found the GPS. I typed in my hotel name and the satnav plotted the route, telling me I had to stop for about 20 minutes halfway along to charge.

I won't review the car for you; it's perfectly pleasant to drive and I wouldn't have any issues replacing my 11-year-old Audi A3 with one when the time comes. But what was rapidly becoming clear to me was that much of how the Tesla works is quite different from a normal vehicle. I'm not saying it's bad, it just doesn't fit into the immediate vocabulary that you're used to when getting into a rental car.

My first battle was with the auto steer function. It seemed to become annoyed with me for looking at the central screen and deactivated itself in a huff, telling me it wouldn't work for the rest of the journey. But the reason I needed to peer at the screen was because much of the information is in a tiny font. Maybe that QR code checks how good your eyesight is.

After a couple of hours, the battery charge was getting low so I pulled into the suggested stop. Supercharging was seamless and I give it an extra ten minutes beyond the required time for luck. As soon as I pulled away, the car said I'd need more. So, I stopped again 30 miles later, and gave it another top up. And then another, because it decided that wasn't enough either. I arrived at Las Vegas with 10% left in the battery, but having been up for some 24 hours I had given up caring.

I'm sure that regular Tesla owners would have instinctively compensated for the cold weather by charging to far higher than the stated requirement – low temperatures and batteries are rarely the happiest of workmates – but at this point I hadn't read the stories about Tesla batteries "dying in the cold".

Over the course of the week, I got to understand the user interface. My initial frustrations started to fade away. But I became firmly convinced that the car desperately needs a "I am new to Tesla" mode which gives a simplified UI, and possibly a 60-second walkthrough of all the things that are different from a normal

**“What was rapidly becoming clear to me was that much of how the Tesla works is quite different from a normal vehicle”**

car. Such things matter for a rental vehicle, especially when you're at the end of an 11-hour flight.

In the future, none of this will matter. I will climb into the back seat, tell the car to take me to Las Vegas, and sit back and snooze. But such RoboTaxi operation seems somewhat far away, especially in the UK.

In the meantime, caution is needed when you have a product that is so significantly different to the established mainstream, especially when you invite tired customers to climb aboard after a transatlantic flight. Getting the formatting wrong in Word is one thing. Controlling a car is quite another.

■ Jon Honeyball is contributing editor of PC Pro and has been since issue one. He likes to be plugged in and enjoys a fast charge. Email [jon@jonhoneyball.com](mailto:jon@jonhoneyball.com)



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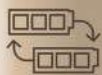
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